The Journal of ELECTRICITY POWER and GAS

DEVOTED TO THE CONVERSION, TRANSMISSION and DISTRIBUTION OF ENERGY.

VOL. XV.—No. 6 SAN FRANCISCO, CAL., JUNE, 1905. YEARLY SUBSCRIPTION - $2.00 SINGLE COPIES - 25 CENTS

1889 PARIS EXPOSITION MEDAL FOR RUBBER INSULATION

OKONITE TRADE MARK

1893 WORLD'S FAIR MEDAL FOR RUBBER INSULATION

SOLE MANUFACTURERS OF

OKONITE WIRE

THE STANDARD FOR RUBBER INSULATION

OKONITE TAPE : MANSON TAPE

CANDEE WEATHER-PROOF WIRE

CANDEE (PATENTED) POTHEADS

THE OKONITE COMPANY, Ltd.,

Willard L. Candee, H. Durant Chcever } Managers
Geo. T. Manson, General Superintendent
W. H. Hodgins, Secretary

253 Broadway NEW YORK

Standard Underground Cable Co.

MANUFACTURERS OF

ELECTRICAL WIRES AND CABLES

Bare and Insulated Wire and Cables for all services.

Large Stocks Carried at Our Oakland, Cal., Factory

PACIFIC COAST SALES DEPARTMENT
Rialto Building, San Francisco, Califoruia
Telephone Main 878
LOS ANGELES OFFICE: Braly Building

FACTORIES: OAKLAND, CAL. PITTSBURG, PA. PERTH AMBOY, N. J.

General Offices: Westinghouse Building, Pittsburg, Pa.

BRANCH OFFICES:
New York, 56 Liberty Street; Philadelphia, Betz Building; Chicago, The Rookery; San Francisco, Rialto Building; Boston, Delta Building; St. Louis, Security Building.

Constant Meese, President *F. Gottfried, Vice-President*
Walter N. Kelly, Secretary

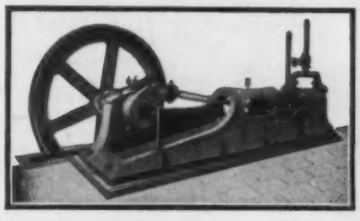
Meese & Gottfried Company.

ENGINEERS AND MACHINISTS

Nº 167 to 179 FREMONT STREET.
TELEPHONE EXCHANGE 487

SPECIALTY.
POWER TRANSMITTING MACHINERY AND ALL PERTAINING THERETO.
AGENTS FOR LINK BELT MACHINERY CO. CHICAGO.

SAN FRANCISCO.



VULCAN ICE MACHINES

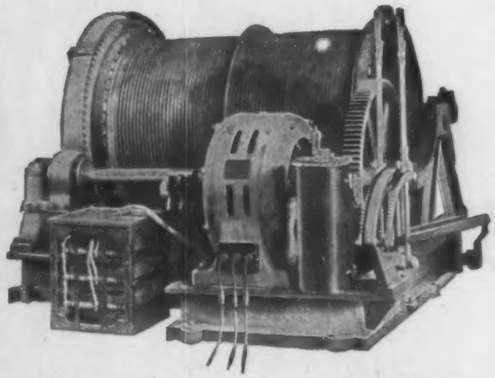
Plate Process Ice-Making Plants

For Making Clear Ice With Electric Power

VULCAN IRON WORKS

505 Mission Street SAN FRANCISCO

The General Electric Company's



Mine Hoists Driven by Direct or Polyphase Motors

Mine Hoists

can be readily shifted to any part of the mine without expense or delay and can be controlled by an operator placed in the most advantageous position

General Offices: Schenectady, N. Y.

San Francisco Office, Crossley Building. Portland Office, Worcester Building. Denver Office, Kittredge Building. Los Angeles Office, Douglas Building
Salt Lake City Office, 25 East First South Street.

INDEX TO CONTENTS PAGE VII. CLASSIFIED LIST OF ADVERTISMENTS PAGE XI. ADVERTISERS INDEX PAGE XVI.

SIMPLEX

RUBBER INSULATED

WIRES

AND

CABLES

Aerial Submarine
Flameproof
Lead Covered Steel Taped

PROMPT ATTENTION TO SPECIAL REQUIREMENTS

THE SIMPLEX ELECTRICAL CO.
110 STATE STREET, BOSTON.

STANDARD ELECTRICAL WORKS
AGENTS
120-130 New Montgomery Street, San Francisco

HELLOO!!

The Standard

are agents for the

De Veau Telephones

TOO

as well as for the

ELECTRICAL MACHINERY COMPANY,
Minneapolis
Direct Current and Alternating Current Generators
Motors, Rotaries, Switchboards

MECHANICAL APPLIANCE CO.,
Milwaukee
Watson Direct-Current Motors, All Speeds, for Direct Connection to Any Tool

ROBB-MUMFORD BOILER CO.
Highest Efficiency Boilers Made

CENTURY ELECTRIC CO.
St. Louis, Mo.
Pillsbury Single-Phase Motors and Fans

AND OTHERS

A Complete Stock of Each, as Well as General Supplies

ASK FOR CATALOGUE OR BULLETINS

and let us know your wants

PORTABLE SET

Standard Electrical Works

RIALTO BUILDING

120-130 New Montgomery St.,

SAN FRANCISCO, CALIFORNIA

TELEPHONE PRIVATE EXCHANGE 580

LONG DISTANCE BRIDGING

President and Director-General of the Lewis and Clark Centennial Exposition and Oriental Fair

President Pacific Coast Electric Transmission Association

President Portland General Electric Company

The Journal of Electricity, Power and Gas.

Devoted to the Conversion, Transmission and Distribution of Energy.

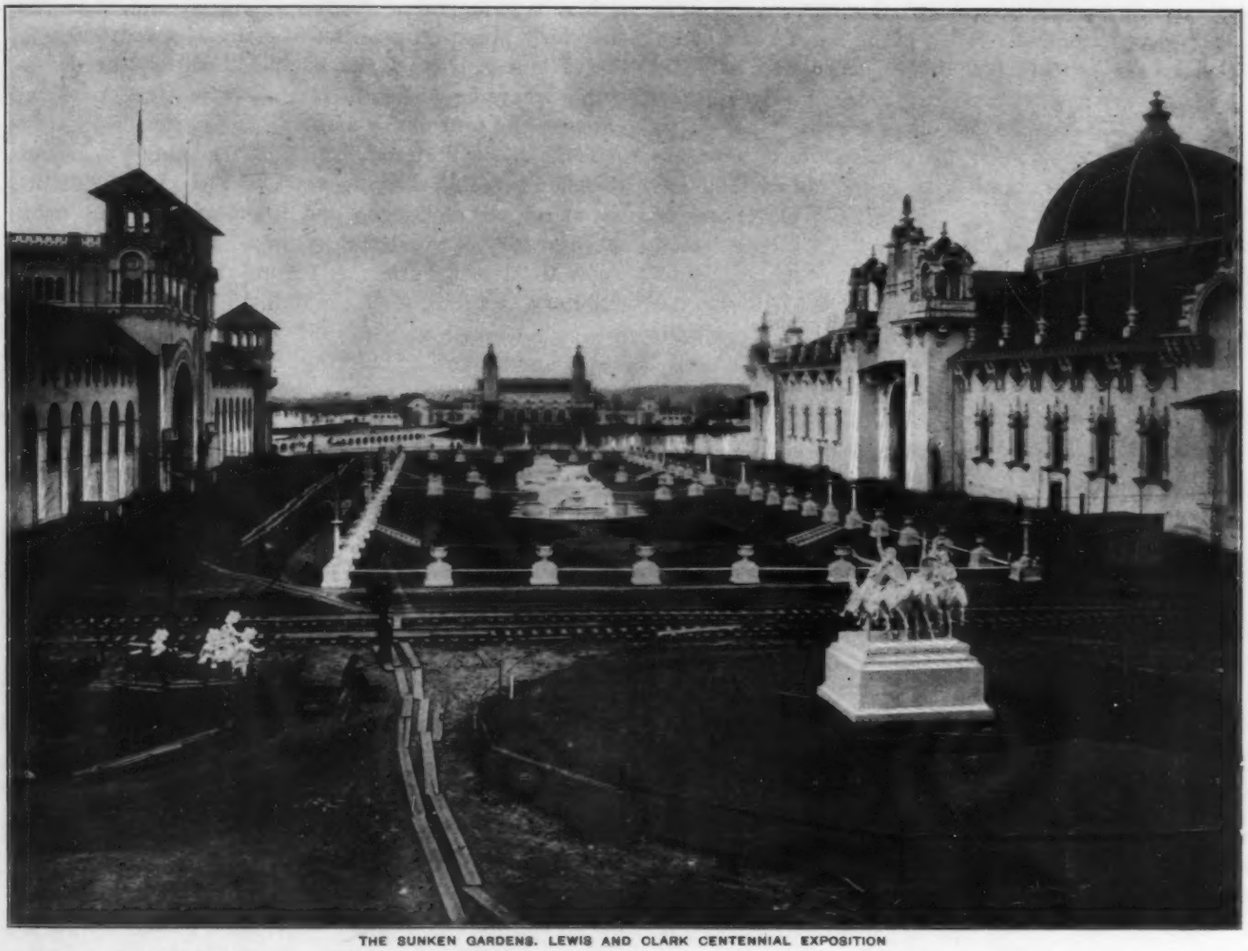
VOLUME XV. SAN FRANCISCO, CAL., JUNE, 1905. NUMBER 6

The Lewis and Clark Centennial Exposition.

THE Lewis and Clark Exposition at Portland, Or., will open Thursday morning, June 1st, at eight o'clock. The Fair might have opened a week previously and then have been more nearly ready than other fairs on opening days; and when the gates are thrown open there will be a sense of completeness about the enterprise which will gladden the hearts of the Oregonians who have stood by the project with money and good cheer, and who have very great hopes for its success.

Announcements just made by Theodore Hardee, assistant to President H. W. Goode, of the Exposition, who has charge of the ceremonies for opening day, explain the arrangements which have been made for the exercises connected with the formal opening of this Western World's Fair.

Departing from the precedent set by earlier fairs, the gates of the Exposition will be opened early in the morning, in order that the crowds may assemble before the exercises. The first demonstration will be a parade of the grounds, in which military, civic and spectacular features will predominate. The formal exercises will be held on the shore of Guild's Lake, where the slope of the ground, terraced and provided with seats, forms a natural amphitheater capable of seating many thousands. The situation of the speaker's stand, on the very edge of the lake, assures excellent acoustics.



THE SUNKEN GARDENS. LEWIS AND CLARK CENTENNIAL EXPOSITION

At noon the immense chimes in the top of one of the 260-foot towers in the Government Building on the Peninsula in Guild's Lake, which will be set in motion by a telegraphic signal sent by President Roosevelt, will peal forth "America," and will then proclaim to the awaiting

thousands that the Western World's Fair is opened. At the same time the wheels in the Machinery, Electricity and Transportation Building will start to revolve, and the Fair will become a thing of life and motion.

The exercises on the lake front will be begun by the famous Innes' Band, which on this occasion will play for the first time a composition by the leader, Frederick Innes, which he has called "Imperial Oregon," and dedicated to the memory of Lewis and Clark. Divine invocation will be made by Right Reverend David H. Moore, Methodist Episcopal Bishop for Oregon and Washington. The remainder of the program has not been completed, but it has been decided already that President Goode, on behalf of the Exposition, Governor George E. Chamberlain, on behalf of the State of Oregon, and Mayor George H. Williams, on behalf of the city of Portland, shall formally welcome the visitors to the Exposition. Honorable James A. Tawney, Representative in Congress from Minnesota, will speak on behalf of the lower house of the National Legislature. The divine benediction will be proclaimed by A. Christie, Most Reverend Archbishop of Oregon, of the Roman Catholic Church.

Every Western State and many in the East have arranged to send representatives to attend the opening exercises, and in many cases these will be Governors of states. Excursions without number have been planned from points throughout the Pacific northwest, as well as from the East, and the attendance is expected to be the greatest during the Fair period, which continues until October 15th.

The Exposition takes its name from two hardy explorers, Captains Meriwether Lewis and William Clark, who, with a little band of followers, pierced the wilderness a hundred years ago and discovered an overland route to the Pacific Ocean, thereby adding by right of discovery and exploration a territory of 307,000 square miles to the holdings of the United States on the American Continent. The event certainly is worthy of suitable commemoration by a centennial exposition, and the fair is worthy of the event. While smaller than the expositions held at Chicago and St. Louis, that at Portland is by great odds the biggest thing ever attempted in the Pacific West, and there are many things about it which make it well worthy of a transcontinental trip. Its world's aspect is secured by the participation of many foreign countries, while State participation is extensive, and the United States Government has a display and buildings which represent an expenditure of $800,000. The Fair has cost $5,000,000 so far, and its exhibit palaces contain displays worth five times as much.

The State of Oregon appropriated for the Fair $450,000, equal to nearly a dollar for every man, woman and child within its boundaries, and the sale of stock in the Fair corporation brought in $430,000 when the city of Portland contained not more than 100,000 inhabitants. Other Western states made generous appropriations, especially California and Oregon, whose legislatures voted respectively $90,000 and $75,000. The Fair on opening day will represent an expenditure of $5,000,000 and its exhibits have an estimated value of five times that sum. The participation which the United States Government has provided could not be duplicated for $800,000, although not all of this sum was appropriated especially for Portland.

One purpose of the Exposition is the exploitation of the Pacific northwest with a view to attracting settlers, and while the National aspect of the Fair is assured by Government participation and representation on the part of fourteen states and the enterprise is made world-wide in its scope through participation of some sort by nearly every nation on the globe, the efforts of the Fair management have been directed primarily toward securing adequate representation of the resources of the Pacific northwest. Every state in this new country is represented by a building and a comprehensive display, while many counties in Oregon, and not a few in the adjoining states, have individual displays. As a result, it is possible for a prospective settler to make a careful study of the various districts of the Pacific northwest before deciding where he wishes to locate, without the time and expense of a tour of the country.

The city of Portland, which is the nation's hostess this summer, is a thriving mart of 140,000 inhabitants, the metropolis of Oregon and the port of a vast tributary territory of wonderful fertility. Portland people are eager to attract settlers either to their city or to the tributary country, and are doing everything in their power to encourage immigration, while the railroads have co-operated by making extremely low rates and providing for numerous stop-overs on which delightful side trips may be taken.

The exposition grounds have natural advantages which are far superior to sites for earlier fairs. The entrance gates are only fifteen minutes by street car from the down-town portion of the city, and they open upon a vista which is held out charmingly and with such good taste that, while the buildings are not crowded together, the long miles of weary wanderings which visitors to early fairs recall so vividly are avoided. The grounds embrace 126 acres of charming woodland, and a natural lake 220 acres, in the center of which is a peninsula, sixty acres in extent, where the United States Government's five magnificent buildings are located.

This Government Peninsula appears to the eye to be a verdure-covered island, on which the gleaming white Government buildings stand like moated castles. Beyond the peninsula and the lake lies the Willamette River, and in the distance four snow peaks—Hood, St. Helens, Adams and Rainier—pierce the sky line. To the west of the grounds, the green foothills of the Cascades reach down to the Exposition fence.

The Fair site is a natural park, and everywhere, except, of course, where the buildings stand or the walks and roads occupy the space, there is green grass with a great deal of shrubbery, especially in Centennial Park, a natural woodland in the western part of the grounds where there are delightful winding paths with rustic benches, on which one may rest, and steps of logs at every

slight ascent. Over the whole grounds, in plats and singly, there are thousands of rose bushes—a total of 15-000—and these are all in blossom, making the place gay with their vivid colors. The exhibit buildings and the State and Manufacturer Pavilions and other structures stand close together, so that there are no long walks to weary the visitor.

The Fair has been ready for nearly two weeks, and not a detail will remain unfinished at the opening hour. The preparedness of the Exposition is characteristic of Western spirit which dominated the movement to hold a great exposition in a city of 140,000 inhabitants and a State whose inhabitants totaled less than half a million. All trains entering Portland leave their passengers at the Union Station. From there, a short street car ride on Fifth Street leads to Washington Street, one of the principal business thoroughfares, and by transferring, one may go direct to the Exposition grounds which are situated in the western part of the city, distant about twenty minutes' ride from the Union Station.

A short street, once devoted to residences but now occupied entirely by booths and stands, which in many cases have been made by tunneling under houses, leads from the car line to the main entrance to the exposition. On either side of the entrance gates are the Administration and Fire Department buildings, with big projecting wings which extend inward like pointing fingers, and inside the gates, perhaps a hundred yards back, is a beautiful colonnade of Ionic pillars. It was intended originally that the entrance gates should be between the pillars of this colonnade, but the Fair outgrew the plans. On alighting from a street car, one walks along a short street where the sandwich man, and the ice cream man, with the vendors of peanuts and fruits, clamor for nickels.

The main entrance to the Exposition grounds is an ornate circular colonnade of a double row of Ionic columns surmounted by a graceful peristyle with highly ornamental balustrades. On the facade are inscribed the prophetic words, of which the Exposition celebrates the fulfillment:

THE COLONNADE ENTRANCE AND ADMINISTRATION BUILDING, LEWIS AND CLARK CENTENNIAL EXPOSITION

"*Westward the Course of Empire Takes Its Way.*"

Columbia Court, the central landscape feature of the Exposition, terminates on the north in Lakeview Terrace, which is one of the beauty spots of the grounds. From a broad parapet at the head of a series of terraces of velvety lawns dotted with beds of blooming roses the Grand Stairway leads down to an ornate boat landing on the

shore of Guild's Lake, the natural "Grand Basin" of the Western World's Fair. The Stairway is flanked on either side by massive balustrades, with pedestals supporting electroliers of frosted lamps. On each side of the Stairway the grounds are terraced and benches are provided for the comfort of visitors who will gather here to listen to the music and witness the pyrotechnic displays on the lake. At the foot of this series of steps is a purling fountain which pours its waters into a basin decorated with water nymphs.

At the left hand end of the white-pillard peristyle which forms the entrance to the Exposition grounds is the Administration Building, a substantial structure 145 feet long by forty feet wide. The building is of ivory white staff, with a hood of red Spanish tiles. The cornice running out to meet the roof shows the projecting rafters. About the two entrances, each fourteen feet wide, are groups of Ionic pilasters. The building will be supplied with an abundance of light and air, glass doors and side lights being set into the walls of the big lobby, which is twenty-four by twenty-eight feet in dimension, with columns supporting the story above. A grand stairway twelve feet wide occupies the center of the building. In addition to the lobby there are sixteen rooms on the first floor and nineteen on the floor above, furnishing accommodations for the Fair directors, clerks, stenographers and others directly connected with the administration of the Exposition.

Beyond the colonnade, the Exposition stretches out to the right and left and forward, but the principal buildings stand close together, like a six-horse team, facing a lake which lies perhaps a quarter of a mile beyond the colonnade. Here the great Columbia Court forms the central feature, corresponding to the wagon tongue, except that it is far more sightly, for the court contains two beautiful sunken gardens and some really creditable statuary. On either side of the Court are the big buildings—European exhibits, Oriental exhibits and Forestry to the left, and Agriculture, Varied Industries and Mines and Metallurgy to the right. For outriders, there are the Machinery, Electricity and Transportation Building; the Auditorium, which seats three thousand people; the Museum of Arts, several manufacturers' pavilions, half a dozen restaurants, the state buildings of Oregon, Massachusetts, California, Washington, New York, Idaho, Utah, Colorado, Illinois and Missouri, the pavilion of Coos County, Oregon, the Young Woman's Christian Association Building and several smaller structures.

These buildings are on the mainland. Guild's Lake is crossed by a broad, handsome bridge of staff and wood, built in imitation of solid masonary, and nearly half a mile long. The Government buildings, five in number, occupy a peninsula which juts into the lake, and are accessible by way of the bridge or by various water craft which ply the placid waters. Twin towers on the main structure, 260 feet high, pierce the sky line. The near end of the bridge is 200 feet wide, and is called the Trail; the far end, fifty feet wide, is called the Bridge of Nations. The Trail is the Exposition's amusement street and it promises to be a hummer. The gaudy, picturesque theatres and similar structures crowd one another on each side of a wide avenue, and spread out at the land end where they line the shore of the lake. A broad walk over the water, called the Lake Shore Esplanade, starts in the extreme east of the grounds and follows the lake shore, passing the band stand at the foot of the Grand Stairway which leads to Columbia Court, intersecting the Bridge of Nations at the place where the Trail ends and ending finally at the American Inn, in the extreme western portion of the grounds.

Such, roughly, is the geography of the Fair. The arrangement of the buildings, close together yet not crowded, is admirable as it makes it possible to see the Fair without the long weary miles of walking that will be remembered so vividly by the visitors to earlier expositions.

In making the Fair a panorama of beautiful things, rather than a catalogue of things for sale and things that "everyone ought to see," the managers willingly give nature more than half the credit. Visitors at the Exposition will be inclined to credit the builders with rare good taste, and will see in the finished whole an Exposition of wonderful attractiveness. There is about it an air of tranquil restfulness which seems almost incongruous in a bustling city like Portland.

The main exhibits buildings cluster at the crest of a gentle slope which leads from the lake shore. Gravel walks intersect grass plots which separate the buildings, and on the hillside the vivid green of the grass contrasts delightfully with the pink and red and yellow of the flower beds which lie like polka-dots on the bosom of the slope. The tall towers of the main Government Building are reflected pleasingly in the placid lake, while in the near distance lies the silvery Willamette, and half a hundred miles farther are the four glorious snow-capped mountains—Hood, Rainier, St. Helens and Adams. To the left—the east—the foothills of the Cascades, clothed in shrubbery with an occasional tall fir tree, reach down to the water's edge. In the western part of the grounds there are experimental gardens in a canyon which separates the grounds proper from the foothills, and on the slope leading to the canyon the natural woodland has been maintained, except that here and there a tree has been culled out in order to let a more beautiful tree flourish, and now and again shrubbery has been planted in fitting places. This part of the site, which is called Centennial Park, is one of the most attractive features of the Fair, and offers a glimpse of Oregon's natural woodland glories which is extremely fascinating. Gravel walks, with their steps of logs at every ascent, cross and recross the shady recesses of the park, and numerous rustic benches offer rest to the weary.

Within the spacious exhibits buildings, the displays are in general such as have been seen at earlier fairs, but are more attractive, being more tastefully arranged. A policy of segregation adopted some time ago provides that all exhibits from Oriental nations shall be housed in one building, and all European exhibits in another.

Japan has more than half of the space in the Oriental Building. A continuation of the segregation policy gives states the privilege of showing their displays in their own buildings, instead of scattering them among the different exhibits palaces, and in every case where a state has erected a building this has been done. Every Western State is represented generously, and the displays enable one to gain a clear idea of different sections of the Pacific northwest without the expense of a visit to them. Nearly every county in Oregon, and many in Washington, California and Idaho, likewise have displays, and one enterprising Oregon County—Coos—has built a large building, the materials for which are all from that county, which is especially rich in fine woods. The new

THE ORIENTAL EXHIBITS BUILDING, LEWIS AND CLARK CENTENNIAL EXPOSITION

things to be seen at the Exposition are for the most part Western things, and are especially interesting to Easterners, who will go to Oregon to see the staff city that is called an Exposition, and the great Oregon country outdoors which is in itself an exposition more glorious than any that man could build.

While the Fair in many respects is similar to former enterprises of a like nature, it has a number of distinctive features that rank as notable attractions. The site itself is one of unusual attractiveness, and the setting which nature has given it enhances its beauty. The foothills of the Cascade Range reach down to the western edge of the grounds. From Lakeview Terrace, at the head of the Grand Stairway, the view embraces the shimmering lake, with the twin towers of the main Government building reflected in it, the Government Peninsula with its staff palaces clustering among the trees, the Willamette River in the near distance, and beyond, half a hundred miles away, the four snow-capped sentinels of Cascade range, which are ever sublime in their grandeur.

Beyond Centennial Park in a small canyon are the Experimental Gardens, another unique feature, wherein all kinds of western crops are seen as they actually grow. The ever-popular promenade known as the Lake Shore Esplanade, extends the length of the grounds, roughly parallel with the lake shore, being built like a bridge on piles over the water. The promenade is a mile long and connects the group of State buildings on the east with the American Inn at the west, passing the music shell and intersecting the Bridge of Nations.

Such are the principal distinctive features. The plan of segregating exhibits has proved extremely popular. All the European exhibits are displayed in one building, and all the Oriental displays in another, while the states which have separate pavilions have gathered all their exhibits within their own buildings.

The Government Building, the general front of which will be in the form of a wide crescent, will present an entrancing sight when lighted at night with thousands of tiny globes. Two towers, located at the ends of the main structure, each 260 feet high, will be literally dazzling pillars of light. Rows of frosted lights will outline

the beautiful peristyle connecting the main part of the building with its two wings, and the wings themselves, which will be used for the housing of the irrigation and territorial exhibits, will be a blaze of electrical beauty. With Guild's Lake, the largest body of fresh water ever enclosed within an exposition fence, special aquatic features, not possible at any previous exposition, are being planned. The submarine illumination of this lake is one of the most attractive of these.

Elaborate electrical water displays are planned for night illumination of Guild's Lake. It has been decided that some sort of a fountain display, managed from a sunken barge, will be arranged, and the arches of the beautiful Bridge of Nations will be outlined in incandescent lamps after the building illuminations have been completed.

Departing from the precedent set at St. Louis, the Portland Exposition has no separate power station on the grounds, but has made an excellent arrangement with the Portland General Electric Company for service, as that company has one of the most modern and elaborately equipped power plants in the United States. For the purpose of supplying power for the Fair, the Portland General Electric Company has installed in its plant two 1500-kilowatt turbines. It has a modern power station situated one-third of a mile from the Fair grounds, and which has a capacity of 10,000 horsepower. All switchboards are located at the power station.

In the illumination of the Fair about 100,000 eight-candle-power frosted lamps are used in outlining the buildings. There are also 5000 fifty-candle-power Meridian lamps used in electroliers on the Bridge of Nations, which connects the Government Peninsula and the mainland, the Lake Shore Esplanade, which follows the shore of Guild's Lake for nearly a mile, and the drive-ways and avenues throughout the grounds. The service is supplied through 2200-volt feeders and is distributed to various transformer pits located just outside the buildings. The secondary wire distribution is 117 volts.

James R. Thompson, the electrical engineer of the Exposition and who has designed the illumination, has conceived a number of entirely new features, chief among which is the submarine illumination of Guild's Lake. On either side of the Esplanade and the Bridge of Nations, at intervals of three feet, fifty-candle-power lamps, in marine receptacles, have been placed on the bottom of the lake. The lake is about six feet deep and its water is clear so that the illumination is sufficient to make it possible for spectators on the Bridge of Nations or the Esplanade to see objects on the bottom. The government fish hatcheries have stocked the lake with black bass, golden carp and salmon trout, and these may be seen swimming about among the water plants. The effect is unique, and unusually pleasing.

In Columbia Court, about which cluster the large exhibition palaces, and on the Government group across Guild's Lake, will be centered the efforts of the exposition electrical staff. The central axes of the Fair, running northwest and southeast through the center of Columbia Court, will cut the center of the main part of the Government Building on the island. Thus it will be seen that whether the spectator is on the peninsula or on the mainland, the view of the grounds when lighted up in the evening will be equally attractive.

A feature of the electrical illumination will be the electroliers. These fixtures, each made up of a graceful cluster of seventeen fifty-candle-power frosted lamps, will be placed around the sunken gardens of Columbia Court, alternating with urns filled with gorgeous flowering plants. Other electroliers will occupy pedestals on the grand stairway, while numerous smaller fixtures, each made up of six lights, will be scattered along the shady walks and through the woods in the western parts of the grounds, and also around groups of statuary.

The general plan of illumination includes outlining every building by means of eight-candle-power frosted lamps. About Columbia Court the effect will be particularly entrancing, four thousand lights being used along the court side of the big Agricultural Palace and three thousand or more on that side of the European Exhibits Building. The great dome of the Agricultural Building will likewise be lighted by the frosted globes, twelve hundred being used. The Colonnade entrance, which is designed to fascinate the pleasure-seeker as he enters the grounds, will be illuminated with a gorgeous display of fifteen hundred lights.

The Oriental Exhibits Building stands between the Forestry Building and the European Exhibits Building, its cream tints shining out in contrast with the dark brown of the former. The structure is 308 by 160 feet in size and cost $55,425. The entrances are on the south, east and west fronts under lofty classic arches sweeping up to the roof with broad cornices. The central part of the roof is a great half cylinder, terminating at the north end in an apex, a skylight all along the apex of the roof admitting abundant light. At each corner are two square turrets, each of which has open arches overlooking small balconies. A tasteful balustrade surrounds the roof and at intervals among its small columns are broad, square pillars which support flags, poles and vases alternately. The side walls are adorned with fluted corinthian pilasters with ornamental capitals, and between each pair of them are windows in two tiers adorned in bas relief. The interior is one large central hall. Six broad stairways, one at each side of each entrance, lead to a gallery over the aisles.

Facing the Concourse Plaza is Festival Hall, the building wherein will assemble all the great conventions, musical festivals and merry-makings that will be notable features of the Exposition. The building, which is 305 feet long and 125 feet wide, is built on an architectural plan similar to that adopted as a general scheme, a free form of the Spanish Renaissance. A huge dome and ten smaller towers give variety to the sky line. The building has a circular truss roof with sky lights, in addition to forty large windows, six feet wide by twenty-two feet high, thus insuring an abundance of light and air. Of the nine exits, four are on the west side and four on the

east, the main entrance on the south being sixteen feet wide, while the side outlets are ten feet wide. The main entrance is of elaborate design, richly ornamented, showing an American eagle with outspread wings. The building will have a total seating capacity of 7000. The main floor contains 39,000 square feet, while the gallery, twenty-five feet wide and running around three sides, has room for 2500 seats. The stage is seventy-five feet in width, and will accommodate at least 500. To the rear of the stage are dressing rooms, ante rooms, etc. The walls of Festival Hall, both inside and out, are of a rich old ivory tint.

The Forestry Building is the unique structure of the Exposition. It is a gigantic log house, exemplifying in its composition the forest wealth of Oregon and Washington. Besides being a timber exhibit itself it will contain all the finished products of the forest as well as the woods in their native state. In its construction two miles of five- and six-foot fir logs, eight miles of poles and tons of shakes and cedar shingles were used. The logs have been left in the rough with the bark on. The base logs of the building are six feet in diameter and fifty-two feet long. The logs above the base are three feet through and vary in length. Colonnades of immense fir trees thirty feet high and six feet in diameter support splendid loggias or galleries over the main entrances. Picturesque balconies grace each end of the building. The portico over one entrance is supported by giant spruce trees and the other shows a colonnade of magnificent hemlocks that will be the marvel of all visitors. The upper part of the building is supported by cedar bark shingles laid eighteen inches to the weather. An overhanging roof adds much to the attractiveness of the structure.

The interior of the building as well as the exterior will be an exhibit of the forest wealth of the northwest. Here a colonnade of fifty-two columns of fir and cedar trees forty feet high supports the roof. Rustic stairways and inside balconies running around the entire building enable the visitor to study the wonderful virgin display of native woods and other products of the forest.

In the construction of the Forestry Building no carpentry work was employed, the logs being framed together with tree-nails and big old-fashioned wooden pins. The forest giants used were cut in the forests bordering on the Columbia River. They were formed into rafts and floated down the Columbia and Willamette rivers into Guild's Lake, whence they were raised to the site of the building in Centennial Park by means of a big skidway 1500 feet long. The distance traveled by the logs in the water was seventy-five miles.

THE EUROPEAN EXHIBITS PALACE, LEWIS AND CLARK CENTENNIAL EXPOSITION

Probably the most astounding feature of the Forestry Exhibit is Oregon's showing of hardwoods. This is the first time that a thorough display of the various hardwoods of the State has been made. These woods are peculiarly adapted to polishing. Some of the effects obtained as a result of this process are beautiful in the

extreme, and the panels compare favorably with the finest veneers ever manufactured. To display the panels, Edmund P. Sheldon, in charge of the Forestry Exhibits, designed a two-sided case. From this pattern fifty cases were manufactured. Each accommodates four panels, which, by the way, are about thirty inches wide and sixty inches long. The woods represented in the panels are larch, alder, cottonwood, fir, spruce, curly pine and cedar. There were obtained from various sections of Oregon where timber abounds. A panel that should attract more than ordinary attention is of fir, an inch thick, sixty inches wide and sixty-six inches long. This exceptionally large panel is in a solid piece and has been highly polished.

In addition to the solid panels a display is made of handsome veneers and also of burls, which is an outgrowth from the side of a tree. Mr. Sheldon has made cross-cuts through these on specimens of spruce, cedar, curly pine and alder, with the result that he has obtained some marvelous grains. These too, have been highly polished and while not suitable for practical use, as ornaments the burls are second to none. The remainder of the timber exhibit is comprised of kindred forest products such as logs, poles, ties, cordwood, paper and wood pulp, shingles, Cascara bark, boxes and trunk materials. Mill products are represented with a large display of moulding, turned articles, carved specimens, sashes and doors. An enterprising timber man has installed a full-sized saw mill which will serve as a practical illustration of the industry.

Fish and game are closely associated with the timber industry. For this reason Mr. Sheldon has seen fit to install a salmon hatchery. This is located in the center of the Forestry Building, and during the Exposition period will be utilized to show piscicultural work. No more beautiful study than the evolution from the egg to the matured vertebrate may be offered. Every phase of fish development, illustrating the manner in which Oregon's streams are kept stocked with the finned beauties, will be shown. In conjunction with this, a model of the bed of the Columbia River exhibiting the fish wheels used for capturing salmon will be maintained. In glass jars will be displayed specimens of various fish found within the confines of the State.

Upon the second floor of the building is located a representation of Mt. Hood and the country adjacent to that wonderful peak. In the foreground of this panorama plastic art has been used. Papier mache rocks and cliffs truthfully portray the wild grandeur that abounds near Mt. Hood. Bits of plant life, scattered here and there in the picture, lend a touch of realism to the illusion. In the background, from among thousands of stately pines and cedars, rises the magnificent snow-clad mountain.

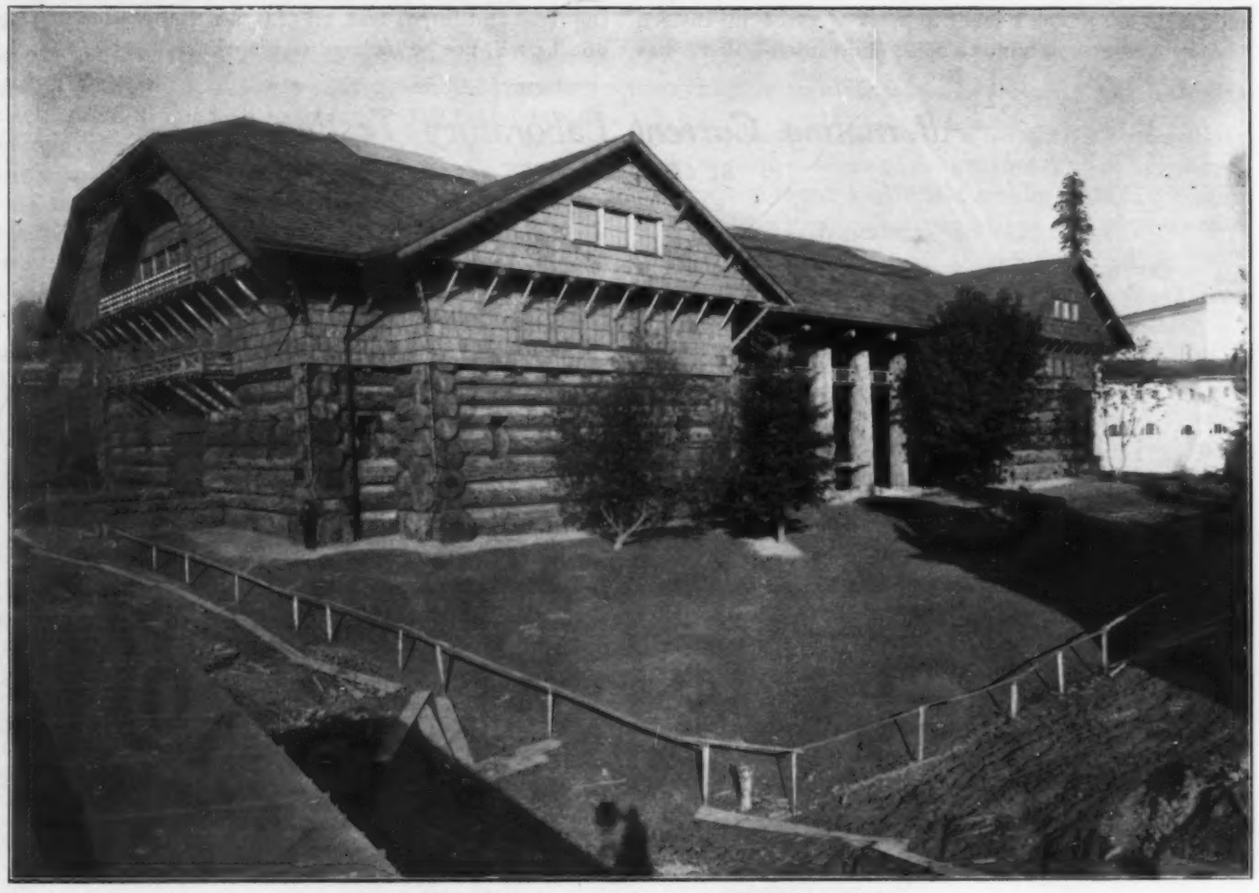
THE GRAND STAIRWAY OF THE LEWIS AND CLARK CENTENNIAL EXPOSITION

The interior rafters of the Forestry Building have been festooned with pine cones and other forest growths which permeate the atmosphere within the walls of this noble structure with the most pleasing of perfumes. Standing in this building, wondering at the many diversities of Oregon's timber wealth and awed by the massive tree

columns that rise on all sides, the visitor must needs appreciate the wonderful works of nature.

The United States Government buildings are of a magnitude and splendor worthy of the Nation and the occasion. There are five buildings in all, the main structure being connected with three smaller ones by ornate peristyles, while the fourth smaller building, the United States Life Saving Station, is located west of the group, on the shore of Guild's Lake. The buildings cost $250,000. The front of the main building is spanned by five arches, each forty feet wide, supported by corinthian columns forty-four feet high. The building is graced by two towers, each of which is 260 feet high and surmounted by a dome. The roof of the main building is arched, the highest point being 130 feet from the ground, while at each end is a half dome. Constructed in the Spanish Renaissance style of architecture, in harmony with the other main exhibition palaces, the building is, from an architectural standpoint, one of the finest in exposition history. It is situated some little distance from the lake which it faces and, being directly opposite Columbia Court, the viwe of the main exposition picture obtained from it is entrancing. The Territorial Pavilion is located to the west of the main building, and the Irrigation Building to the east, the Fisheries Building behind the latter. The minor buildings are in the same style as the main structure, but with less ornamentation.

The European Exhibits Building stands on the left of Columbia Court, and the stately building is in the design of the Spanish Renaissance and possesses many graceful features. Each corner of the structure is set off by towers having open arches on the sides guarded by ornamental balustrades. The main entrance is through a huge semi-circular arch. The face of the arch is richly adorned with flowers, vases and allegorical figures woven into a scroll of bas relief. From the center of the building rises a huge tower, topped on each corner by smaller towers. In the center is a roof garden, the sides of the tower forming a surrounding loggia. Here, during the Exposition, will be located a first class restaurant where one may dine and view the surrounding scenery to good advantage. At each end of the structure between the corner towers is a broad vestibule divided into three arches by plain, square pillars. Each archway leads to a wide double door below a decorated classic window and above each arch is a highly ornamental quatrefoil window. The main walls are relieved by similar windows in the upper tier, the lower tier being of simple design. Within the building broad stairways lead from each corner and the middle of the east and west walls to the towers and roof garden. Ample light is furnished from skylights along the center of the roof. The building is 100 by 462 feet in size and cost $51,720. All exhibits from European countries are installed in this structure.



THE FORESTRY BUILDING, LEWIS AND CLARK CENTENNIAL EXPOSITION

On Guild's Lake there will be realistic life-saving drills by actual life-savers in the employ of Uncle Sam. There is plenty of room in Guild's Lake for a real rescue.

In the Agriculture Building there are, besides the canned goods and the famous "innumerable varieties," and the baby food displays, prunes as big as peaches that give the lie to the boarding house joke which classes them with hash. Then there are apples which are far bigger than those that grow in the back yards at home, and much redder and more luscious than those in the barrel in the cellar at your house. Oregon apples are packed in boxes, and bring as good prices as oranges.

In the Mines and Metallurgy Building there are exhibits of Oregon gold ore. Since 1861, when a party of emigrants left a blue bucket to mark a place in eastern Oregon where they found a soft yellow metal, there has been $200,000,000 worth of gold taken from Oregon mines. In some parts of Oregon the residents raise crops in summer and dig gold in the winter. For the purpose of investigating a black sand which is quite common on the Pacific Coast, the United States Government has built an annex to the Mines and Metallurgy Building, and the experiments which will be carried on there are likely to prove that this black sand is the world's greatest mineral source. This building itself, constructed of immense logs, contains the most remarkable showing of forestry products ever made. The Oregon forests are there in epitome. It has been estimated that there is an aggregate of 300,000,000,000 feet of lumber, board measure, standing in the uncut trees of Oregon. This figure seem incredibly large, but when one sees the size of some of the trees and learns how great is the timber area of Oregon he will not be inclined to disbelieve it.

Alternating Current Laboratory Testing.

BY GEORGE H. ROWE

PART II—CONTINUED.

HEAT TEST OF ALTERNATORS.

The general principles of the rise of temperature in machines are given in articles 26 to 36 of the report of the Standards Committee of the American Institute of Electrical Engineers. See, also, Foster's Electrical Engineer's Pocket Book, pages 263–306.

Put full load (non-inductive) on the machine by means of water boxes, and observe the current, electromotive force in each phase and the temperature in the following parts, by thermometer.

Time	E. M. F. Arm.	Amp. Arm.	Amp. Field.	Speed.	Room Temp.	Temp. Field.	Temp. Arm.	Temp. Ringg.

When the temperature becomes stationary, quickly stop the machine and determine the rise of temperature by thermometer and by increase of resistance method of the following parts:

Armature core surface.
Field winding by resistance.
Field winding by thermometer.
Field spider by thermometer.
Collector rings by thermometer.
Pole tip (leading).
Pole tip (trailing).
Bearings.
Frame.

INSULATION RESISTANCE.

This test* is sometimes omitted. It is usually taken with an electromotive force equal to rated voltage of the machine, through a voltmeter of which the resistance is known. The resistance between the armature and the frame, field and frame should be found, connections being made as in Figure 43. Continuous current electromotive force must, of course, be applied in this test.

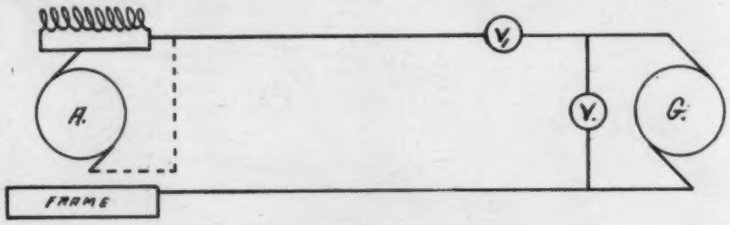


FIGURE 43

If r = insulation resistance
R = resistance of voltmeter V_1
e = reading of V_1
E = reading of V

Then $r = \left(\frac{E}{e} - 1\right)R$

The resistance r must not be less than one megohm.

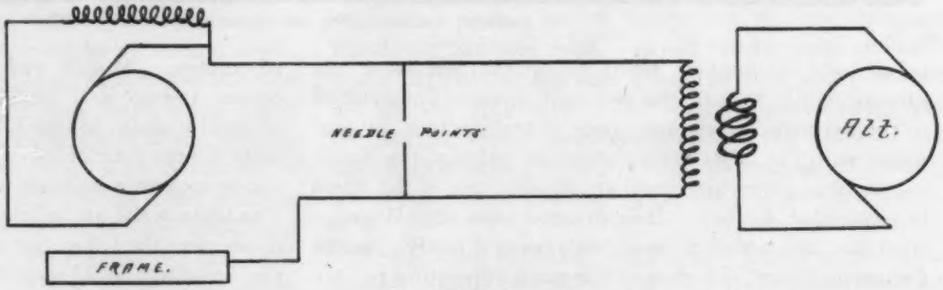


FIGURE 44

DIELECTRIC TEST.

This test* is taken on the assembled machine before being put into use. Connect as in Figure 44. The

*Article 37, A. I. E. E. Stand. Com.

*Article 38–50, A. I. E. E. Stand. Com.

sparking distances in air being given in Appendix V of the Standards Committee of the American Institute of Electrical Engineers, and the proper voltages to be applied in Article 43 of the same report.

FORM FACTOR OF THE ALTERNATOR

The formula

$$E = 4.44 \times T \times \sim \times \phi$$

is true only in the case of a sine wave of electromotive force. For any other wave the formula becomes

$$E = \frac{\lambda \times 4.44 \times T \times \sim \times \phi}{10.8}$$

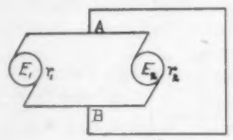
where λ is the ratio of the average value of the given wave to the equivalent sine wave.

The form of the wave will depend on the shape of the pole pieces, that is on the distribution of the flux in the air gap; on the ratio of the width of coil to the pole arc; on the distribution of the windings; on the variation in field strength due to a variation in the reluctance of the magnetic circuit; on the variation of the "effective resistance" of the armature circuit, and on the variation of the reactance of the armature circuits. The last mentioned causes are active only when the machine is under load. The wave form is therefore not necessarily the same on open and closed circuits.

The electromotive force wave should be taken on both open circuit and when the alternator is fully loaded. These can be conveniently taken by means of the oscillograph. The ordinates of the oscillographic wave should of course be accurately proportional to those of the original wave.

PARALLEL OPERATION OF ALTERNATORS.

In Figure 45 let E_1 and E_2 be the electromotive force of two continuous current shunt generators running in parallel; let also the armature resistance plus armature reaction of each machine be r_1 and r_2 respectively. Then if r_3 is the resistance of the external circuit and I_1, I_2 and I_3 the currents in E_1, E_2 and r_3 respectively, and e the electromotive force across AB, we have



FIGUTE 45

When $E_1 - r_1 I_1 = E_2 = e$

$I_2 = O$

And $I_3 = I_1 = \frac{e}{r_3}$

And when $E_2 - r_2 I_2 = E_1 = e$

$I_1 = O$

And $I_3 = I_2 = \frac{e}{r_3}$

For values of e between these limits both machines will act as generators sending power into r_3. For any other values of e, either E_1 or E_2 will run as motors.

When both act as generators, then

$e = E_1 - r_1 I_1$

$e = E_2 - r_2 I_2$

$I_3 = I_1 + I_2 = \frac{e}{r_3}$

Solving the equations for e, we have

$$e = r_3 \frac{(r_1 E_2 + r_2 E_1)}{r_1 r_2 + r_1 r_3 + r_2 r_3}$$

$$I_1 = \frac{E_1 r_2 + E_1 r_3 - E_2 r_3}{r_1 r_2 + r_1 r_3 + r_2 r_3}$$

$$I_2 = \frac{E_2 r_1 + E_2 r_3 - E_1 r_3}{r_1 r_2 + r_1 r_3 + r_2 r_3}$$

Under the above conditions these machines would divide the load in amperes in the ratio of

$$\frac{I_1}{I_2} = \frac{E_1 r_2 + E_1 r_3 - E_2 r_3}{E_2 r_1 + E_2 r_3 - E_1 r_3}$$

Or the load in watts

$$\frac{W_1}{W_2} = \frac{(E_1 r_2 + E_1 r_3 - E_2 r_3) E_1}{(E_2 r_1 + E_2 r_3 - E_1 r_3) E_2}$$

In the usual particular case

$E_1 = E_2$

Then currents in the two dynamos are inversely as their effective resistances, or $\frac{I_1}{I_2} = \frac{r_2}{r_1}$, and the same is is true of the ratio of loads. Therefore, two machines with the same percentage of armature drop or regulation from no load to full load will share the loads in the ratio of their capacities. This conclusion has been reached assuming that E_1 and E_2 are constant in value from no load to full load. This will not be the case in practice on account of the drop in speed of the prime mover. But if the regulation curves of the prime movers are similar, and the drop in the ratio of the full load capacities of E_1 and E_2, the two machines will still share the loads proportionately.

When $E_1 = E_2$, and $r_1 = r_2$, and the output of E_1 equals output of E_2 and the regulation of engine E_1 equals regulation of engine E_2, then the two machines will share the load equally.

Similar reasoning can be applied to the case of alternators in parallel by the use of symbollic method. See Steinmetz' Alternating Current Phenomena, page 314.

Graphically the relations of the electromotive forces and currents can be represented as in Figure 46, taken from Jackson's Alternating Currents, page 351.

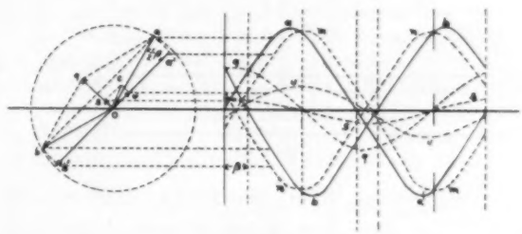


FIGURE 46

Let Ob represent the electromotive force of one alternator and Oa that of the other, the angle between them being $180 - B$. Then Oq is the resultant electromotive force. It produces a current

$$C = \frac{2 E \sin \frac{1}{2} B}{\sqrt{R^2 + L^2 \omega^2}}$$

Where R and L are the resistance and inductance of one machine connected to busbars, that is in parallel with other machines.

This current consists of two components, one in phase with the resultant pressure, *Is*, and one in quadrature, *Ou*, and therefore wattless. From the figure it will be seen that the component *Ou* leads one machine and lags behind the other, tending to accelerate the former and retard the latter, the component *Os* being equally displaced from *Ob* and *Oa* will have no effect in bringing the machines into phase.

The current C will be large if the impedance is small. The phasing component of the current

$$C_u = C \sin qoc$$

$$= \frac{2\,E \sin \tfrac{1}{2} B}{\sqrt{R^2 + L^2\omega^2}} \cdot \frac{\omega L}{\sqrt{R^2 + L^2\omega^2}}$$

$$= 2\,E \sin \tfrac{1}{2} \sin B \cdot \frac{\omega L}{R^2 + L^2\omega^2}$$

It will be seen that C_u is large when L is small, and will be a maximum when $R = \omega L$, R remaining constant.

Then $tan\ qoc = 1$,

or $qoc = 45^\circ$

Alternators for lighting commonly have good regulation, that is their synchronous reactance is relatively small. They have large synchronizing power, but are apt to be too sensitive for operation in parallel. The synchronizing power may be dangerously high. Alternators to be run in parallel and synchronous motors are commonly made with more reactance, that is, their regulation is inferior.

In the foregoing discussion equal impressed electromotive forces and equal impedances of the two alternators are assumed. In other words, the terminal electromotive forces were the same. Two machines of the same design will therefore have identical field excitations. If the

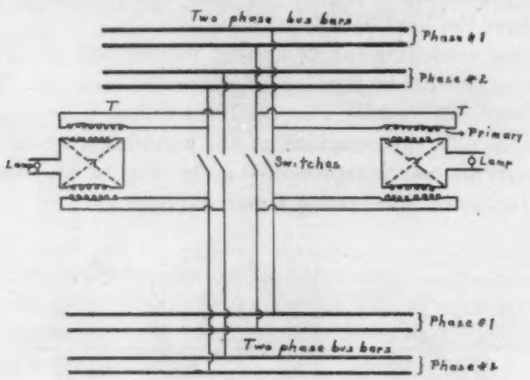


FIGURE 47

compounding curves differ, the field excitation must be varied until the drop due to the internal impedance of the two machines gives equal terminal voltage. The proper total voltage for each machine can be calculated from the synchronous impedance curve.

Calculate the proper excitation in volts to carry the load, bring the alternator to synchronism by means of a synchronizer, as shown below, throw machines together when opposite in phase. Then regulate the load of the alternator by regulation of the prime mover. This can easily be done in the case of water motors, and in the case of steam engines by the use of governors which are adjustable while the engine is running. The reverse operation is performed when the alternator is thrown out of service.

Changing the field excitation will not change the load as in the continuous current paralleling.

Connections for synchronizing may be made as in Figure 47. For dark lamps, connect the secondaries of the transformers T as shown by full lines, for bright lamps connect as shown by dotted lines. In synchronizing the various phases of a polyphased generator all lamps must be bright or dark at the same time; if this is not true the phase rotation of the generator to be thrown in is wrong and should be reversed by reversing the connections of one phase.

VARIATION AND PULSATION.

The causes tending to produce a variation in the rate of rotation during one revolution of an engine are:

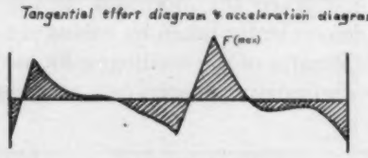
First—The variation of steam pressure acting on the pistion.

Second—The variation in direction in which the steam pressure is applied to the crank, due to variation in relative positions of crank and connecting rod.

Third—Inertia of the reciprocating parts.

Fourth—Variation of the load.

In figure* is shown the tangential effort diagram of a single crank engine during one complete revolution



FIGURES 48-49

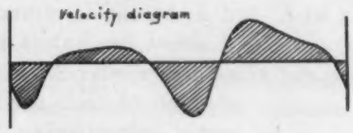


FIGURE 50

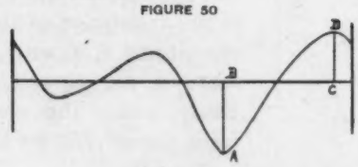


FIGURE 51

derived from the indicator cards with known ratio of connecting rod to crank arm, and corrected for weight and inertia of reciprocating parts. Figure 49 is the acceleration diagram of the crank; Figure 50 is the velocity diagram, and Figure 51 is the displacement diagram of the crank pin. Figure 49 is obtained from Figure 48 from the relation force equals mass times acceleration. Figure 50 is the integral of 49, and 51 is the integral of 50.

The maximum variation from perfectly uniform rotation is the ordinate AB in Figure 31.† The displacement is ordinate $AB + CD$

*Astrom, A. S. M. E., May, 1901.

†A. I. E. E., Article 71, Standards Committee.

The maximum speed variation is the ordinate AB and the speed displacement from the mean is $AB + CD$ in Figure 50. For parallel operation of alternators direct connected to engines the fly wheels and cranks must be so designed that the speed variation is small.

The Westinghouse Company requires a variation not exceeding 1-60 of the angle between two adjacent poles. Thus, for a twenty-pole alternator the permissable variation on either side of uniform rotation might be 3-10 degreee, or .08 per cent. of the circumference. The corresponding displacement will be .6° approximately, the maximum variation for each half revolution not being necessarily equal.

The General Electric Company specifies a variation of 2½-360° of the angle between two poles. For a twenty-pole alternator this will be .25 of a degree. Variation in electrical degrees will be $\frac{N}{2}$ times the angular variation where N is the number of poles.

The following is an approximate relation between speed displacement and angular displacement:

$$A = \frac{360}{C_4} \times \frac{S}{2} = \frac{45^\circ S}{2} *$$

$$E = \frac{N}{C_4} \times 180^\circ \times \frac{S}{2}$$

$$E = \frac{NA}{2}$$

Where A = angular displacement in degrees,
S = speed displacement,
C = the number of cranks, and
E = the electrical phase displacement.

*See H. E. Longwell, *Power*, July, 1902.

It has been found by working out the angular variations for engines having three cranks that the displacement is no better than that for the two-crank engine, so that in the formula C must be taken equal to two for a three-crank engine.

If the maximum variation for the twenty-pole alternator considered above is .25°, the maximum displacement will be .50° and the maximum speed displacement will be approximately

$$.5 = \frac{360}{4} \times \frac{5}{2}$$

Or $S = \frac{4}{360} = 1.112$ per cent.

The corresponding phase displacement wonld be 5°. If two similar twenty-pole alternators are thrown together, when one is ahead 2½ electrical degrees and the other behind 2½ electrical degrees, the cross current between them will be

$$I = \frac{E \sin 5^\circ}{Z_0}$$

Where E is the electromotive force of either alternator and Z_0 is the impedance of either.

Then $I = .0871_0$ where I_0 is the short circuit current of the alternator and equals $\frac{E}{Z_0}$ for full load excitation. If I_0 is twice full load current, then the cross current is 17.4 per cent. of load current.

The above argument has assumed uniform load on each engine. If the cross current changes the loads the short circuit current should be specified as well as the angular variation.*

*Steinmetz' Elements of Electrical Engineering, page 158.

On the Economy of Steam Power Plants Using Oil Fuel—IV.*

Continued from page 190 of The Journal for May, 1905.

While the efficiency guarantee at rated capacity of individual units is a very important quantity in determining selection of engines, boilers, electrical apparatus and auxiliaries, combining to determine the complete plant duty that may be expected under test conditions, it must be borne in mind that the actual conditions under which commercial plants are operated are far from ideal, the yearly average showing an economy much less than developed during the acceptance test.

ECONOMY DUE TO VARIABLE LOAD.

The fact that certain plants, under unfavorable conditions, may average less than 50 per cent. of their maximum economy, emphasizes the importance of giving this subject the most careful consideration. The causes of losses are numerous, but are principally due to the fact that all steam power plant apparatus is less efficient at fractional loads than at rating. Aside from the inevitable losses due to the characteristic curves of the individual units, there are in the boiler room those important losses occasioned by cutting in and out boilers, blowing off boilers, radiation and standby losses from idle boilers, radiation from steam piping not in active service, and finally, the more formidable loss in oil burning plants due to carelessness or negligence of firemen, usually manifesting itself in the form of a large excess of air over and above the requirements for combustion. In the engine room there are losses due to starting and stopping of units, improper adjustment of valves, steam leakages past improperly fitting valves, and largely due to not maintaining the full vacuum in condensers, losses of vacuum being due to air leakages, unnecessary elbows, too small exhaust piping, etc.

Particularly in a lighting plant with a rapidly increasing load during the early hours, and a rapidly decreasing load during the later hours, there is an uncertainty as to the rate of load variation, necessitating the use of a larger number of units in service at any one time, as a matter of precaution, than would be necessary were the given load to remain stationary for any number of hours. Corresponding to this there is a still lower percentage load on the individual units and a corresponding further loss of economy.

To attempt to calculate, even approximately, the ratio of economy under such conditions to that experienced under duty trial, would seem, at first thought, an absurdity. No two plants have the same form of load curve, operating conditions, nor the same factor of allowance for human indifference and negligence. The writer has been able to analyze, in a measure, the various losses noted above, and having made comparison with the similar results obtained in a large number of existing plants, ventures to offer such figures given in Table No. 17. This table is considered merely a temporary expedient, to serve until something more reliable can be complied. It is thought that an analysis showing the method of arriving at these figures would be of interest and an aid in collecting further and more reliable data along these lines.

*Written for THE JOURNAL by the Engineering Department of Chas. C. Moore & Co., Engineers, Inc.

Starting with the known duty of plant, under test conditions continuous load at rated capacity, the losses have been classified and calculated as follows:

First—The general decline in economy of plant, assuming it were to operate continuously under full load, is assumed at 10 per cent. This figure has been taken from the results of a number of water works pumping stations, which offer the closest parallel, such plants having a practically uniform load. This allowance covers the loss due to improper adjustment of valve gear, falling off in vacuum, cutting in and out of engine units, loss due to firing up cold boilers, careless firing, etc., in carefully operated plants; but this loss may be considerably greater in plants poorly designed and carelessly managed.

Second—Due to variable load on direct connected engine and generator unit, the mechanical losses within unit have been calculated according to curve given by Jas. A. Seymour, in the *Electrical World and Engineer*, of April 2, 1904. Based upon this curve, and assuming a combined efficiency of say, 87½ per cent. at full load, there would be the following efficiencies of units, at fractional loads:

Percentage of full load output measured at switchboard.	Combined efficiency of engine and direct connected generator.
100 per cent.	87½ per cent.
75 per cent.	85.7 per cent.
50 per cent.	81.5 per cent.
25 per cent.	71 per cent.

In the larger units the combined efficiency at full load, may be as high as 90 per cent. or 95 per cent. in certain types of units. Based upon the above efficiencies of direct connected unit and the known performances of a cross compound condensing engine of type commonly used on this Coast, operating on saturated steam, a curve of relative efficiency was plotted, from which the following figures are taken:

Percentage of full load output measured at switchboard.	Economy of steam consumption in percentage of full load economy.
100 per cent.	100 per cent.
75 per cent.	97 per cent.
50 per cent.	88 per cent.
25 per cent.	68 per cent.

Based on the use of superheated steam, there would be considerable increase in relative economy at the fractional loads.

As a further step, based upon the above performances, the relative fuel consumption of complete plant, operating continuously at any given fractional load, was calculated from the known efficiency of boiler at fractional loads, from power required by auxiliaries, and by assuming the same total loss due to heat radiation from steam piping at all loads, as follows:

Percentage of full load output measured at switchboard	Relative fuel consumption per kilowatt-hour in percentage of fuel economy at full load.
100 per cent.	100 per cent.
75 per cent.	94 per cent.
50 per cent.	82 per cent.
25 per cent.	54 per cent.

These results are as close as may be estimated for a medium size unit; rate of decrease in economy would be somewhat greater for smaller units, and still less for larger units, and as stated above, considerably less, particularly at fractional loads, with superheated steam.

Third—Total fuel consumption for the given load curve only has been calculated from curves from which the above data is taken. In case of two or more units, a second unit has been cut into service at the moment the load reached rated capacity on the units then in service. From that moment there will be a fractional load on these units until load reached rating and another unit then cut into service, etc. This assumption is slightly in error, for the reason that the plant operatives usually allow themselves some leeway, using such a number of units as will never allow any of the units to operate at full load on a rising peak. In the case of railway plants, particularly of the smaller sizes there should be a further correction, owing to the fact that the load is continually changing, producing a saw-tooth effect, super-imposed on a rising load curve. It has been further assumed that the peak load of plant will correspond exactly to the rated capacity of all units in service during peak. In general this assumption is rather unfair to plant economy for the reason that there is usually a slight overload during peak, the effect of which is to decrease more rapidly the fixed charges than to increase the fuel charges during this interval. There is a further saving, owing to the fact that there is less loss in fuel by operating the boilers at an overload during the short interval of peak, than the stand-by loss occasioned by the extra number of boilers being kept under steam during the remainder of the twenty-four hours.

Fourth—In all plants it is assnmed that boilers in service during the peak load are kept under banked fires or in operation the entire twenty-four hours run, even though the actual run should be only ten or twenty hours per day. When complete plants consist of two or more units, it is assumed that a proportion of the total boiler units are in actual service at any time corresponding to the number of engine units then in service.

The stand-by losses due to banked fires or idle boilers have been variously calculated by different authorities, but the most authentic data is probably given in Kent's book, entitled "Steam Boiler Economy," wherein these hourly losses are assumed at 3⅓ per cent. of fuel consumption at rated capacity of boilers. This figure has been assumed throughout as the hourly stand-by loss, although properly it should be modified for very large or very small units.

Were the oil burners to be operated sufficiently to keep boilers under full steam the entire interval, these losses would be somewhat greater, but this is not customary in commercial plants, merely being the practice in reserve plants to be in readiness for immediate starting of plant.

Fifth—It is assumed that all the main steam piping and auxiliary steam piping is continuously kept under full steam pressure and that the same total hourly loss by radiation from steam piping is experienced during the lower loads as at full load. Further, this hourly loss due to radiation and leakage has been figured at 2 per cent. of the fuel consumption during peak load. This figure is also dependent upon plant design, character of joints, etc.

These various items of loss in economy are itemized and summarized for plants having, one, two, three and four units, for 100 per cent., 50 per cent. and 33⅓ per cent. curve load factors and for a length of run of ten, twenty and twenty-four hours per day, in accompanying Table No. 17.

Example—In a one unit plant operating continuously at full load the fuel consumption is assumed as 10 per cent. greater than guaranteed. On the same plant operating only ten hours per day, at full load, the effect of the stand-by losses is to increase the fuel consumption. On the other hand at one-third load factor twenty-four hours per day, the fuel consumption would be 74 per cent. greater for a one unit plant or 30 per cent. greater for a four unit plant; and finally, for the same load factor ten hours per day, the fuel consumption would be 98 per cent. greater for a one unit plant and 54 per cent. greater for a four unit plant than the guaranteed duty for twelve-hour test rated capacity uniform load. As stated above, these derived results have been compared with figures obtained from actual practice and agree as closely as could be expected for figures of this class.

As before stated, it should be borne in mind that for exceptional forms of load curve the foregoing figures may require considerable modification. There are also ramshackle plants having losses not enumerated above, which plants, however, are not subject to further consideration in this article. Finally, as mentioned previously, there are losses due to excess of air supply and other allied losses, which may vary considerably the figures given.

TABLE 17—POWER PLANT ECONOMY—RELATIVE FUEL

Table showing approximate amount and distribution o

CHAS. C. MOORE CO., ENGINEERS, INC.

Number of Units in Power Plant....	Fuel Consumptio																	
	100 Per Cent. Curve Load Factor												50 Per Cen					
	Plant Running Full Loaded and Under Test Conditions—Duty		Losses Due to Variable Load on Engines and Generators		Losses Due to Variable Load on Boilers, Auxiliaries, Etc.		Losses Due to Banking Fires and Radiation from Idle Boilers and Piping		Assumed Loss Due to Difference Between Regular Operating and Test Conditions		Total		Plant Running Full Loaded and Under Test Conditions—Duty		Losses Due to Variable Load on Engines and Generators		Losses Due to Variable Load on Boilers, Auxiliaries, Etc.	
	Duty		Duty		Duty		Duty		Duty		Duty		Duty		Duty		Duty	
	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Pe Cent. Tota
TWENTY-FOUR HOURS																		
1	100	90.91	.....	.....	.....	.....	.....	.....	10	9.09	110	100	100	71.43	12.00	8.57	18.00	12.
2	100	90.91	.....	.....	.....	.....	.....	.....	10	9.09	110	100	100	75.76	8.07	6.11	12.46	9.
3	100	90.91	.....	.....	.....	.....	.....	.....	10	9.09	110	100	100	79.37	6.61	5.25	6.29	4.
4	100	90.91	.....	.....	.....	.....	.....	.....	10	9.09	110	100	100	80.65	5.76	4.65	4.70	3.
TWENTY HOURS PE																		
1	100	90.09	.....	.....	.....	.....	1	.90	10	9.01	111	100	100	70.42	12.00	8.45	18.00	12.
2	100	90.09	.....	.....	.....	.....	1	.90	10	9.01	111	100	100	74.63	8.07	6.02	12.46	9.
3	100	90.09	.....	.....	.....	.....	1	.90	10	9.01	111	100	100	78.13	6.61	5.16	6.29	4.
4	100	90.09	.....	.....	.....	.....	1	.90	10	9.01	111	100	100	79.37	5.76	4.57	4.70	3.
TEN HOURS PER																		
1	100	83.34	.....	.....	.....	.....	10	8.33	10	8.33	120	100	100	64.10	12.00	7.69	18.00	11.
2	100	83.34	.....	.....	.....	.....	10	8.33	10	8.33	120	100	100	67.57	8.07	5.45	12.46	8.
3	100	83.34	.....	.....	.....	.....	10	8.33	10	8.33	120	100	100	70.42	6.61	4.65	6.29	4.
4	100	83.34	.....	.....	.....	.....	10	8.33	10	8.33	120	100	100	71.43	5.76	4.11	4.70	3.

NOTES—1 The above figures are approximate only and should be used with caution.

2 Table based on dry saturated steam at 150 pounds gauge pressure.

3 All engines are of the compound condensing type, having reheating receiver and governor controlling admi

4 All auxiliaries are steam driven.

5 Table is based on typical load curves from actual plants, ranging in size from 250 to 500 kilowatt units. Wit

6 Curve load factor is defined as ratio of average load to maximum load, as shown by the average daily load cu
four hours per day plants only.

7 In all cases the peak load of curve is assumed corresponding to rated capacity of plant without overload.

8 The use of superheated steam would show a marked improvement in any of the above plants, particularly wi

TIVE FUEL CONSUMPTION AT FRACTIONAL LOADS—OIL FUEL.

stribution of losses due to variable loads, stand-by losses, etc.

SAN FRANCISCO, CAL.

Consumption Per Unit of Output																			
50 Per Cent. Curve Load Factor								Full Under Duty	33⅓ Per Cent. Curve Load Factor										
Losses Due to Variable Load on Boilers, Auxiliaries, Etc.		Losses Due to Banking Fires and Radiation from Idle Boilers and Piping		Assumed Loss Due to Difference Between Regular Operating and Test Conditions		Total		Plant Running Loaded and Test Conditions—Duty	Duty		Losses Due to Variable Load on Engines and Generators		Losses Due to Variable Load on Boilers, Auxiliaries, Etc.		Losses Due to Banking Fires and Radiation from Idle Boilers and Piping		Assumed Loss Due to Difference Between Regular Operating and Test Conditions		Total	
In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total	In Per Cent. of Duty	In Per Cent. of Total
OUR HOURS PER DAY PLANT																				
18.00	12.86	.....	.....	10	7.14	140	100	100	57.47	23.70	13.62	40.30	23.16	.....	.....	10	5.75	174	100
12.46	9.44	1.47	1.11	10	7.58	132	100	100	70.92	12.35	8.76	12.54	8.90	6.11	4.33	10	7.09	141	100
6.29	4.98	3.10	2.46	10	7.94	126	100	100	76.34	8.60	6.56	4.17	3.19	8.23	6.28	10	7.63	131	100
4.70	3.77	3.54	2.86	10	8.07	124	100	100	76.92	8.16	6.28	2.38	1.83	9.46	7.28	10	7.69	130	100
HOURS PER DAY PLANT																			
18.00	12.68	2.00	1.41	10	7.04	142	100	100	56.50	23.70	13.39	40.30	22.77	3.00	1.69	10	5.65	177	100
12.46	9.30	3.47	2.59	10	7.46	134	100	100	69.44	12.35	8.58	12.54	8.71	9.11	6.33	10	6.94	144	100
6.29	4.92	5.10	3.98	10	7.81	128	100	100	74.63	8.60	6.42	4.17	3.11	11.23	8.38	10	7.46	134	100
4.70	3.72	5.54	4.40	10	7.94	126	100	100	75.19	8.16	6.14	2.38	1.78	12.46	9.37	10	7.52	133	100
HOURS PER DAY PLANT																			
18.00	11.55	16.00	10.25	10	6.41	156	100	100	50.51	23.70	11.97	40.30	20.35	24.00	12.12	10	5.05	198	100
12.46	8.42	17.47	11.80	10	6.76	148	100	100	60.61	12.35	7.48	12.54	7.60	30.11	18.25	10	6.06	165	100
6.29	4.44	19.10	13.45	10	7.04	142	100	100	64.52	8.60	5.55	4.17	2.69	32.23	20.79	10	6.45	155	100
4.70	3.36	19.54	13.96	10	7.14	140	100	100	64.94	8.16	5.30	2.38	1.54	33.46	21.73	10	6.49	154	100

ling admission of steam to both high and low pressure cylinders.

nits. With smaller units standby losses will be greater—with larger units less.

ly load curve, and must not be confounded with yearly load factor. Curve load factor is the same as yearly load factor for twenty-

rload.

cularly with the lower load factors.

TABLE 18—POWER PLANT ECONOMY—APPROXIMATE COST OF POWER A

Costs based on installation at Pacific Coast railroad term

CHAS. C. MOORE & CO., ENGINEERS, INC.

Total Rated Capacity of Plant, Kw.	Type of Engine	No. of Units	Size of Units, Kw.	Total First Cost of Plant—Dollars. Does Not Include Real Estate or Piping Outside of Building Walls	Total Fixed Charges Per Year—Dollars. See Table No. 15	Total Cost of Labor Per Year—Dollars.	Kw. Hours Per Barrel of Oil, 12 Hour Test	100 Per Cent. Curve Load: Supplies Per Kw. Hour—Cents	Water Per Kw. Hour—Cents	Kw. Hours Per Barrel of Oil	Fixed Charges, Labor, Supplies and Water, Per Kw. Hour—Cents	Fuel Per Kw. Hour at $1.00 Per Bbl.—Cents
							TWENTY-FOUR HOURS PER DAY PLANTS					
50	High-speed, tandem, compound, non-condensing, D. C.	1	50	11,900	1,547	2,700	98	.060	.176	89	1.206	1.124
75	High-speed, tandem, compound, non-condensing, D. C.	1	75	15,200	1,976	2,700	101	.050	.176	92	.938	1.087
100	High-speed, tandem, compound, non-condensing, D. C.	1	100	18,100	2,353	2,700	110	.040	.169	100	.786	1.000
100	High-speed, tandem, compound, condensing, D. C.	1	100	20,300	2,639	2,700	116	.040	.016	105	.666	.952
150	High-speed, tandem, compound, condensing, D. C.	1	150	25,200	3,276	2,700	116	.035	.016	105	.506	.952
300	Cross compound, condensing, direct connected	1	300	44,200	5,746	3,840	175	.030	.011	159	.406	.629
500	Cross compound, condensing, direct connected	1	500	64,000	8,320	7,140	185	.020	.010	168	.383	.595
750	Cross compound, condensing, direct connected	1	750	76,900	9,997	8,040	194	.020	.010	176	.305	.568
1,000	Cross compound, condensing, direct connected	1	1,000	95,000	12,350	10,500	205	.017	.010	186	.288	.538
1,500	Cross compound, condensing, direct connected	1	1,500	135,800	17,654	12,060	217	.017	.009	197	.252	.508
2,500	Cross compound, condensing, direct connected	2	1,250	260,000	33,800	14,340	217	.017	.009	197	.246	.508
5,000	Cross compound, condensing, direct connected	3	1,650	471,000	61,230	21,600	217	.015	.009	197	.213	.508
10,000	Cross compound, condensing, direct connected	4	2,500	862,000	112,060	37,620	221	.013	.009	201	.193	.498
20,000	Manhattan type, 4-cylinder, condensing, D. C.	4	5,000	1,480,000	192,400	71,280	225	.013	.009	205	.173	.488
							TWENTY HOURS PER DAY PLANTS					
50	High-speed, tandem, compound, non-condensing, D. C.	1	50	11,900	1,547	2,700	98	.060	.176	88	1.400	1.136
75	High-speed, tandem, compound, non-condensing, D. C.	1	75	15,200	1,976	2,700	101	.050	.176	91	1.080	1.099
100	High-speed, tandem, compound, non-condensing, D. C.	1	100	18,100	2,353	2,700	110	.040	.169	99	.901	1.010
100	High-speed, tandem, compound, condensing, D. C.	1	100	20,300	2,639	2,700	116	.040	.016	105	.787	.952
150	High-speed, tandem, compound, condensing, D. C.	1	150	25,200	3,276	2,700	116	.035	.016	105	.597	.952
300	Cross compound, condensing, direct connected	1	300	44,200	5,746	2,760	175	.030	.011	158	.429	.633
500	Cross compound, condensing, direct connected	1	500	64,000	8,320	4,260	185	.020	.010	167	.375	.599
750	Cross compound, condensing, direct connected	1	750	76,900	9,997	5,220	194	.020	.010	175	.308	.571
1,000	Cross compound, condensing, direct connected	1	1,000	95,000	12,350	6,960	205	.017	.010	185	.292	.541
1,500	Cross compound, condensing, direct connected	1	1,500	135,800	17,654	9,300	217	.017	.009	195	.272	.513
2,500	Cross compound, condensing, direct connected	2	1,250	260,000	33,800	13,200	217	.017	.009	195	.284	.513
5,000	Cross compound, condensing, direct conneeted	3	1,650	471,000	61,230	20,520	217	.015	.009	195	.248	.513
10,000	Cross compound, condensing, direct connected	4	2,500	862,000	112,060	37,560	221	.013	.009	199	.227	.503
20,000	Manhattan type, 4-cylinder, condensing, D. C.	4	5,000	1,480,000	192,400	71,280	225	.013	.009	203	.203	.493
							TEN HOURS PER DAY PLANTS					
50	High-speed, tandem, compound, non-condensing, D. C.	1	50	11,900	1,547	1,800	98	.060	.176	82	2.070	1.220
75	High-speed, tandem, compound, non-condensing, D. C.	1	75	15,200	1,976	1,800	101	.050	.176	84	1.605	1.191
100	High-speed, tandem, compound, non-condensing, D. C.	1	100	18,100	2,353	1,800	110	.040	.169	92	1.347	1.087
100	High-speed, tandem, compound, condensing, D. C.	1	100	20,300	2,639	1,800	116	.040	.016	97	1.272	1.031
150	High-speed, tandem, compound, condensing, D. C.	1	150	25,200	3,276	1,800	116	.035	.016	97	.978	1.031
300	Cross compound, condensing, direct connected	1	300	44,200	5,746	4,740	175	.030	.011	146	.999	.685
500	Cross compound, condensing, direct connected	1	500	64,000	8,320	4,740	185	.020	.010	154	.746	.649
750	Cross compound, condensing, direct connected	1	750	76,900	9,997	5,580	194	.020	.010	162	.599	.617
1,000	Cross compound, condensing, direct connected	1	1,000	95,000	12,350	5,580	205	.017	.010	171	.518	.585
1,500	Cross compound, condensing, direct connected	1	1,500	135,800	17,654	7,860	217	.017	.009	181	.492	.553
2,500	Cross compound, condensing, direct connected	2	1,250	260,000	33,800	7,860	217	.017	.009	181	.483	.553

NOTES.—1 The above figures are approximate only and are subject to considerable variation, depending on operating conditions, etc. Firs

2 All plants are without economizers or superheaters.

3 Table is based on dry saturated steam at 150 pounds gauge pressure at boiler.

4 All auxiliaries are assumed steam driven. In all cases the circulating pumps are assumed to do 1000 foot-pounds of work per p twenty-foot head. All plants located at tide water. Cooling towers increase first cost and decrease economy.

5 Water is assumed to cost 25 cents per 100 cubic feet. Make-up water is assumed to be 10 per cent. of total in all condensing pla

6 Grade of oil is assumed 18,850 B. T. U. per pound, weighing 336 pounds per barrel.

7 Curve load factor is defined as ratio of average load to maximum load, as shown by the average daily load curve, and must not four-hours-per-day plants only.

8 In all cases the peak load of curve is assumed corresponding to rated capacity of plant without overload.

9 The use of superheated steam would show a marked improvement in fuel consumption in any of the above plants, particularly

Copyright applied for by Chas. C. Moore & Co., Engineers, covering the tables appearing in this article.

POWER AT SWITCHBOARD—OIL FUEL.

ilroad terminal points.

SAN FRANCISCO, CAL.

Water, Per Kw. Hour—Cents.....	Fuel Per Kw. Hour at $1.00 Per Bbl.—Cents.....	Total Expenses Per Kw. Hour With Fuel 50c. Per Bbl.—Cents.....	Total Expenses Per Kw. Hour With Fuel 75c. Per Bbl.—Cents.....	Total Expenses Per Kw. Hour With Fuel $1.00 Per Bbl.—Cents.....	Kw. Hours Per Barrel of Oil.....	Fixed Charges, Labor, Supplies and Water, Per Kw. Hour—Cents.....	Fuel Per Kw. Hour at $1.00 Per Bbl.—Cents.....	Total Expenses Per Kw. Hour With Fuel 50c. Per Bbl.—Cents.....	Total Expenses Per Kw. Hour With Fuel 75c. Per Bbl.—Cents.....	Total Expenses Per Kw. Hour With Fuel $1.00 Per Bbl.—Cents.....	Kw. Hours Per Barrel of Oil.....	Fixed Charges, Labor, Supplies and Water, Per Kw. Hour—Cents.	Fuel Per Kw. Hour at $1.00 Per Bbl.—Cents.....	Total Expenses Per Kw. Hour With Fuel 50c. Per Bbl.—Cents.....	Total Expenses Per Kw. Hour With Fuel 75c. Per Bbl.—Cents.....	Total Expenses Per Kw. Hour With Fuel $1.00 Per Bbl.—Cents.....
50 Per Cent. Curve Load Factor											**33⅓ Per Cent. Curve Load Factor**					
PLANTS																
206	1.124	1.767	2.048	2.329	70	2.270	1.429	2.984	3.341	3.698	56	3.320	1.786	4.212	4.659	5.105
938	1.087	1.481	1.753	2.025	72	1.740	1.389	2.434	2.782	3.129	58	2.528	1.724	3.391	3.822	4.253
786	1.000	1.286	1.536	1.786	79	1.446	1.266	2.079	2.396	2.712	63	2.094	1.587	2.888	3.285	3.682
666	.952	1.142	1.380	1.618	83	1.297	1.205	1.900	2.201	2.502	67	1.926	1.493	2.672	3.045	3.418
506	.952	.982	1.220	1.458	83	.981	1.205	1.583	1.188	2.186	67	1.453	1.493	2.199	2.572	2.946
406	.629	.720	.877	1.035	125	.787	.800	1.187	1.387	1.587	101	1.166	.990	1.661	1.908	2.156
383	.595	.681	.829	.978	132	.748	.758	1.127	1.316	1.506	106	1.111	.943	1.583	1.819	2.055
305	.568	.589	.731	.873	139	.591	.719	.951	1.131	1.310	111	.876	.901	1.326	1.552	1.777
288	.538	.557	.691	.826	146	.560	.685	.902	1.073	1.244	118	.830	.848	1.253	1.465	1.677
252	.508	.506	.633	.760	155	.489	.645	.811	.973	1.134	125	.724	.800	1.124	1.324	1.524
246	.508	.500	.627	.753	164	.474	.610	.779	.931	1.084	154	.696	.649	1.021	1.183	1.346
213	.508	.467	.594	.721	172	.408	.581	.699	.844	.990	166	.599	.602	.900	1.051	1.201
193	.498	.442	.566	.690	178	.369	.562	.650	.790	.931	169	.541	.592	.837	.985	1.133
173	.488	.416	.538	.660	181	.328	.553	.605	.743	.881	173	.480	.578	.769	.914	1.058
LANTS																
400	1.136	1.968	2.252	2.536	69	2.662	1.449	3.387	3.749	4.112	55	3.908	1.818	4.818	5.272	5.727
080	1.099	1.630	1.904	2.179	71	2.029	1.409	2.733	3.085	3.438	57	2.962	1.754	3.839	4.278	4.717
901	1.010	1.406	1.659	1.911	77	1.681	1.299	2.331	2.655	2.980	62	2.447	1.613	3.253	3.656	4.059
787	.952	1.264	1.502	1.740	82	1.542	1.220	2.152	2.457	2.762	66	2.293	1.515	3.051	3.430	3.808
597	.952	1.073	1.311	1.549	82	1.164	1.220	1.774	2.079	2.384	66	1.728	1.515	2.485	2.864	3.243
429	.633	.746	.904	1.062	123	.835	.813	1.242	1.445	1.648	99	1.238	1.010	1.743	1.995	2.248
375	.599	.674	.824	.973	130	.732	.769	1.117	1.309	1.501	105	1.087	.952	1.563	1.801	2.039
308	.571	.594	.737	.879	137	.599	.730	.964	1.145	1.328	110	.887	.909	1.341	1.569	1.796
292	.541	.562	.697	.832	144	.567	.694	.915	1.088	1.262	116	.841	.862	1.272	1.488	1.703
272	.513	.529	.657	.785	153	.529	.654	.856	1.019	1.183	123	.785	.813	1.191	1.394	1.598
284	.513	.540	.668	.796	162	.550	.617	.859	1.013	1.167	151	.810	.662	1.141	1.307	1.472
248	.513	.504	.633	.761	170	.479	.588	.773	.920	1.067	162	.704	.617	1.013	1.167	1.322
227	.503	.478	.604	.730	175	.438	.571	.723	.866	1.009	165	.644	.606	.947	1.099	1.250
203	.493	.449	.572	.695	179	.389	.559	.668	.808	.948	168	.571	.595	.869	1.018	1.166
NTS																
070	1.220	2.680	2.985	3.290	63	4.036	1.587	4.830	5.227	5.623	50	5.969	2.000	6.969	7.469	7.969
605	1.191	2.201	2.498	2.796	65	3.111	1.539	3.881	4.265	4.650	51	4.586	1.961	5.566	6.056	6.546
347	1.087	1.890	2.162	2.434	71	2.602	1.409	3.306	3.658	4.010	56	3.827	1.786	4.720	5.167	5.613
272	1.031	1.788	2.045	2.303	74	2.520	1.351	3.195	3.533	3.871	59	3.759	1.695	4.607	5.031	5.454
978	1.031	1.494	1.751	2.009	74	1.934	1.351	2.610	2.947	3.285	59	2.882	1.695	3.730	4.154	4.577
999	.685	1.341	1.512	1.684	112	1.979	.893	2.426	2.649	2.872	88	2.954	1.136	3.522	3.806	4.090
746	.649	1.070	1.233	1.395	119	1.478	.840	1.898	2.108	2.318	93	2.206	1.075	2.744	3.013	3.282
599	.617	.908	1.062	1.216	124	1.185	.807	1.588	1.790	1.991	98	1.767	1.020	2.277	2.532	2.787
518	.585	.811	.957	1.103	131	1.025	.763	1.406	1.597	1.788	104	1.527	.962	2.008	2.248	2.489
492	.553	.768	.906	1.045	139	.973	.719	1.332	1.512	1.692	110	1.450	.909	1.904	2.131	2.359
483	.553	.759	.897	1.035	147	.952	.680	1.292	1.462	1.632	132	1.413	.758	1.791	1.981	2.170

, etc. First cost depending on location, freight rates, etc.

work per pound of steam on main engine, which is the equivalent of pumping fifty pounds of water against a

densing plants. Cost of water and supplies per kilowatt hour vary with the load factor, being the least at full load.

d must not be confounded with yearly load factor. Curve load factor is the same as yearly load factor for twenty-

particularly with the lower load factors.

Based upon all the foregoing considerations, Table No. 18 is computed, showing total cost of power at switchboard per kilowatt-hour, based on all the ordinary conditions to be met with in practice. Table shows total first cost of plant, including steam and electrical machinery, building, foundations, but not including real estate or circulating water piping outside of building walls. There is also stated the total fixed charges per year, based upon Table No. 15, also the total cost of labor per year, as previously explained. Based upon the known performances of the most economical types of boilers engines and steam-driven auxiliaries, the test duty would be realized as shown, expressed in kilowatt-hours per barrel of oil. The falling off in duty, due to fractional load, stand-by losses, etc., is carefully considered, and the actual operating duty for any size plant under the different load factors and lengths of run should be obtained in practice as indicated.

TOTAL COST OF POWER AT SWITCHBOARD PER KILOWATT-HOUR

For example—Where it would be possible in a 1000-kilowatt plant to obtain a duty of 205-kilowatt hours per barrel of oil under test run, the actual duty of this plant under 33⅓ per cent. curve load factor, ten hours per day run, is assumed at 104-kilowatt hours per barrel of oil, which is, of course, an extreme, but shows the conservatism of calculations.

The total cost per kilowatt, including fixed charges, labor, supplies and water, but not including fuel, is given for each plant under each given load factor, as is also given the fuel cost based on $1.00 per barrel. For any other price per barrel, it is merely necessary to multiply the figures given for $1.00 per barrel by the actual cost, add this to the total of fixed charges, labor, etc. The total cost has been figured, including fuel, based upon oil at $.50, $.75 and $1.00 per barrel. Before using these figures the reader should carefully review the footnotes given at bottom of table.

It should be particularly noted that results given are based upon saturated steam plants with steam-driven auxiliaries, but without fuel economizers. There would be a marked improvement in economy of plant, particularly at low load factor, when using superheated steam. There would also be a gain in plants having fuel economizers under certain conditions of load and prices of fuel.

The smaller plants are all given as having one unit, particularly with a view to the use of such installations as reserve steam plants. Under certain conditions of low load factor and high priced fuel, it would be preferable to divide some of the smaller plants even into a number of smaller units, thus decreasing the relative losses due to a larger unit operating for any length of time at light load. It must not be forgotten, however, that while there is a relative improvement as compared with full load economy, due to a larger number of units, there is, as well, a decrease in the full load economy due to the fact that the unit would be smaller in size and consequently less economical.

The larger plants specified are figured as commercial operating plants, and not as reserve steam plants. Cost therefore is based upon brick buildings of modern construction. The size and number of units assumed in these plants is arbitrary and is not offered as being proper selection under all conditions. A glance at the figures will show a surprisingly low cost per kilowatt-hour, even in very small plants. A commercial lighting and power plant should have a load factor in the neighborhood of 33⅓ per cent. based on either twenty or twenty-four hours run. A street railway plant will have a load factor averaging about 50 per cent. There are certain classes of industrial and mining plants and central power plants, for pumping stations, where the load factor may reach as high as 80 per cent. or 100 per cent. In these instances the cost of power production is remarkably low, and the steam power plant becomes a formidable rival of the electric transmission system.

(Continuation in next issue.)

PUBLICITY AS AN AID TO MANUFACTURERS.*

BY ARTHUR WARREN.

A DEPARTMENT of Publicity is a trade scout. It goes out in advance, a long way in advance, of the army of salesman, and stirs up the possibilities of business.

Order is the first law of heaven and publicity. So we have to plan an effective system to get effective publicity. A good part of efficiency is promptness. And to be prompt you must plan ahead.

My notion of a Department of Publicity is that it is a sort of newspaper, and its management is not unlike that of a great newspaper. I had the good fortune to be brought up in a great newspaper establishment, under one of the ablest editors this country ever knew, and, in publicity, my endeavor has been to combine the best newspaper methods with the best methods of the industrial world. How far short of this ideal the result falls no one knows so well as I, and, on the other hand, no one is more clearly aware of the difficulties in the path.

But difficulties exist in order that we may overcome them. When we have overcome them all we shall be ready to enter upon that state of perfect bliss where there is no more publicity.

Don't take a narrow view of publicity. Don't swamp productive work with clerical work. A general in command cannot fire the guns, can notcount the ammunition used in battle, and cannot tabulate the list of slain and of wounded—on the other side.

Advertising, whether direct or indirect, must be done generously if it is to bring results. The chief thing is to let the world know who you are, where you are, and what you are doing; and you can not do this on a large scale by stopping to take a census every time you fire a volley.

I am a believer in direct advertising, as well as indirect; in the mailing list, as well as in the best trade journals. Each does what the other cannot do. Each is essential.

A company's printed matter is a measure of the company's standing. It cannot be too good. The best is the cheapest. Anything else puts you in a poor light. Tons of printed matter go out from all the advertisers in the country. Tons of it go straight to the waste basket. But the best of it finds its way to the customer's desk or bookshelf and is consulted when wanted. The best is not overdone and is never likely to be. The art of it all is to make your printed matter so good that the men you want to reach will always welcome it, and will always pick it out from the mass of matter that comes streaming in with each day's mail.

Publicity is an earning power. But the manifestations of this power have hardly yet begun. We have to make them so strong and fruitful that they will force themselves upon the attention of the manufacturing world in a way that even yet they have not done. There is so much more to do. We have to educate the manufacturing world to regard publicity as a revenue earner, not as a mere expense. Some manufacturers when hungry for business cut down their publicity expenses—cut down one of their means for making sales. When business is flourishing they say they do not need publicity; their shops are full of work. You remember the story of the Irishman's leaky roof. Pat couldn't mend the roof in rainy weather and on fine days it didn't need mending. Evidently we have some missionary work to do.

CRUDE OIL IN TRACK SPRINKLING.

It is the experience of the Southern Pacific Company that 40,000 gallons of crude oil from the Kern River district will sprinkle eleven miles of railroad track for a space of three feet outside of each rail. The sprinkling car, which is steam heated, is run at a speed of from four to five miles per hour, depending upon the viscoscity of the oil, which sprinkles best at a temperature of 90 degrees Fahrenheit. Two coats are generally given, and the life of this coating varies greatly, being indefinitely long with some characters of roadbed, while with others it may necessitate renewing within two or three years.

*Excerpts from an address delivered before the annual dinner of the Manufacturers' Advertising Club, Cleveland, O., May 9th. As is well known, Mr. Warren is manager of publicity for the Allis-Chalmers Company.

Absorption of Electromagnetic Waves by Living Vegetable Organisms.

BY MAJOR GEORGE O. SQUIRE.

THE difficulty of transmitting electromagnetic waves over land as compared to that over sea has been well established, and this difficulty is attributed in a large measure to the general absorption of intervening hills, vegetation, buildings and conductors through which the wave trains must pass in reaching the receiving apparatus.

However closely we may approximate the theory to the actual mechanism of electromagnetic wave transmission, as used in wireless telegraph practice at present, it is now reasonably certain that both the earth itself and the space above the earth are essentially involved in the phenomena.

Repeated experiment has shown the importance of good earth connections for both the transmitting and receiving antennæ, and several letters patent, such as those of Lodge, Muirhead, Fessenden and Stone, provide, in addition, for special conducting metallic nets, or strips, at the foot of the antennæ, extending therefrom to a distance of a quarter wave length or more, whereby the efficiency is increased.

The influence of the general condition of the earth around the foot of the antennæ as to moisture, temperature, and ingredients, has also been noted, and the effects of the capacity of the aerial itself, its height, and of elevated capacity areas placed at or near the end of the vertical wire, have been investigated in connection with the recent great advance in syntonized systems.

For best results, it has been observed in general that the vertical wire or net should be carefully insulated from all supporting poles, guys, or indeed any electrical conductor connected to the earth, the object being to form an open vertical receiving circuit insulated in the air.

We may therefore, with advantage, as Fleming and others have done, regard the general function of the vertical receiving wire and its accessories, as serving to unite electrically the earth and space effects above mentioned, by which, through the agency of one of the forms of wave detectors, a sufficient amount of the energy of the radiating waves is localized to operate a suitable receiving device.

It was from a general survey of the above established facts regarding the receiving conditions for successful wireless transmission of intelligence, that the writer was led recently to consider how far these conditions may be fulfilled by growing vegetation, particularly in the form of high trees covered with green leaves.

My attention was first attracted by learning from Major General Arthur MacArthur, United States army, of a successful experiment made in July, 1904, at the military maneuvers of the Department of the Columbia, at American Lake, Washington, by Lieutenant William M. Goodale of the United States signal corps, in which he found that in laying rapid telephone lines in a wooded country, for the field exercises of the Army, a much better ground could be obtained by attaching the earth side of the instrument to an iron nail driven into the trunk of a tree or shrub, than by the ordinary and more laborous method of burying a conducting plate, or by driving an iron spike into the earth itself.

At the subsequent joint military maneuvers of the Department of California at Camp Atascadero, California, in August, 1904, opportunity was afforded the writer to test the efficiency of this simple means of earthing telephone and "buzzer" telegraph circuits in a country where, due to the extremely dry condition of the soil to considerable depths at that season, it was found very difficult, if not impossible, to use the ordinary single wire grounded circuit even when great care was taken in making the "ground." By using a tree, however, for a ground connection, a telephone or telegraph station could be established in a few moments, with excellent results.

It is found that the conductivity of a growing tree in a healthy state, for telephonic currents, is such that the earth contact nail need not be at the root of the tree, but may be carried to a height up the tree of thirty feet or more, and the telephone used from that elevation with satisfactory results. Indeed, experiment shows that good communication can be maintained from one tree top to another with the trunks of both trees in that circuit. When the operator holds the ground wire in the hand, and completes the circuit to earth by merely touching a live twig or leaf, the transmission of speech is good. This permits the military scout to use the vantage point of the tree elevation for observing the enemy, while being screened from view by its foliage, and at the same time, to transmit by telephone to the distant station, the information thus obtained.

The experiments described below were conducted principally at Fort Mason, San Francisco, California, where the United States signal corps has a wireless telegraph station, and between this point and Alcatraz Island, San Francisco Bay, another wireless station of the signal corps, at a distance of about one and one-half miles.

Later, the naval wireless station at Yerba Buena Island, at a distance of three and one-fourth miles, was also used as a transmitting station, through the courtesy of Admiral Whiting United States navy.

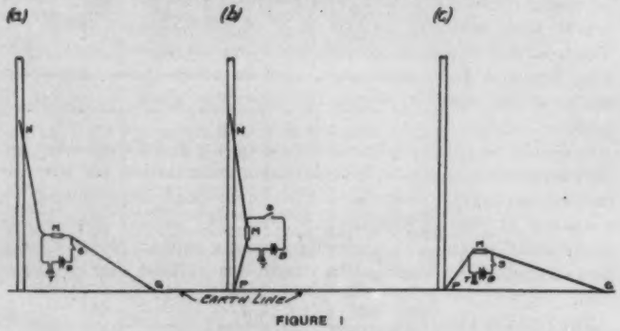


FIGURE 1

A grove of eucalyptus trees on the lawn in front of Major-General Arthur MacArthur's quarters at Fort Mason was utilized as a receiving station.

The experiments thus far have been mainly qualitative, and the apparatus used, of marked simplicity.

In testing the effects of different arrangements of receiving circuit, and of capacities and inductances in its branches, it was more convenient to use the station at Fort Mason for transmitting, which is about 320 yards distant from the trees utilized as receiving antennæ.

The transmitting apparatus at Fort Mason consists of a small Apps induction coil of about four-inch spark, and a vertical antenna wire suspended from a seventy-five-foot pole situated on a bluff about eighty feet above sea level. This was one of the first wireless stations installed in the United States.

The detector used consists of a simple microphone made by partially filling a small ebonite tube with the regular sized spherical carbon granules used in telephone transmitters, and by imbedding therein two steel needles as electrodes so that they nearly touch each other at the central part of the tube.

This apparatus, which serves to give roughly quantitative results, decoheres itself readily, an occasional slight tapping with the hand being all that is required to keep it sensitive.

A head telephone was used to interpret the signals.

No attempt has been made thus far to determine to what ultimate distances this method may be employed for wireless signaling,

since this is dependent upon many things, notably high power in the sending apparatus, and extreme sensitiveness in the receiver.

The experiments described have reference to the general features of the phenomena observed. The wave length employed in most of the tests was about 300 feet, corresponding to a frequency in free space of 3.27×10^6 per second.

In Figure 1 are shown three typical arrangements of receiving circuits, which have been found efficient in practice. In this figure a growing tree is represented by the double line.

In Figure 1 (a), N represents a point of electrical contact with the tree, made in any convenient manner, such as by driving an ordinary iron nail or pin into the tree, preferably through the outer, living part thereof.

The point G represents a conducting contact with the earth, made by driving a metallic pin therein. M is a microphone; T, a telephone; and B, a source of electromotive force.

In Figure 1 (b) and (c), the corresponding letters represent similar apparatus.

The first experiments tried were with an arrangement of circuits indicated in Figure, 1, (b).

The electrical contact with the tree at the point P, was made by driving a nail into the tree itself an inch or two above the earth line, so that the contact would be distinctly with the tree, and not with the earth. The whole apparatus used for these preliminary experiments was extremely simple, consisting of a few feet of flexible lamp cord, a microphone, with three small dry cells, and a head telephone receiver, suitably mounted on a small board about ten by twelve inches.

With the electrical contact at the point P remaining stationary, the upper point N was shifted up and down the tree, effects being noted. In this experiment, the transmitting station remained unaltered as far as possible, sending a simple signal, such as the letter S. It was found that as soon as the distance PN became more than three or four feet, faint signals were heard, which in general increased in loudness with the distance between P and N, along the trunk or stem of the tree, up to the general region where the first branches began to diverge, beyond which a further increase could not be certainly noted.

In order to insure that the effects observed were actually due to electromagnetic waves from the tree itself, and not to the short antenna wire represented by MN, in (a) and (b), Figure 1, a careful exploration of the tree was made, using lead-covered insulated wire for the connections PM and MN, the lead covering of this short antenna being carefully grounded, so that the actual wire used was incased throughout in an earth-connected metallic conductor, which would effectually screen the electromagnetic waves from affecting the wire inside. With such a wire, with the point P remaining stationary, experiments were made, showing that as soon as the distance PN became more than about three feet for the particular distance and apparatus used, faint signals began to be heard. Upon removing the terminal an inch or two away from the tree, still keeping it at the same height above the earth, the signals disappeared entirely, returning again when electrical contact was restored. These effects increased in general, as the distance PN became greater.

Metallic net screens of fine mesh were also used to protect the whole receiving apparatus, and were placed close to the tree on the side toward the receiving station, and above the height of the point N for a considerable distance.

A tree selected behind a masonary embankment eight feet high, and growing close up against the wall and on the side directly opposite the sending station, was also used for receiving purposes, so that the whole receiving apparatus, including the upper contact was considerably below the surface of the ground sustained by the retaining wall. These conditions did not preceptibly interfere in receiving signals through the tree.

The method employed in these experiments has the disadvantage of requiring the results to be interpreted by relative intensities of sound to the human ear, which method is well known to be unreliable in general, as compared with any method involving an instrument, for instance, where deflections may be read by the eye, yet the effects were so pronounced and unmistakable that they were readily confirmed by repeated tests.

It was found that the upper contact point N could be made either to a metallic nail or pin, driven into the tree trunk, its smaller branches, or by pressing the wire against its leaves, buds or flowers.

Since a verticle wire, earthed at its lower extremity, possesses a potential node, and a current anti-node for electromagnetic waves at approximately the point where the wire intersects the earth line, it was thought that a growing tree, which can be regarded as a vertical conducting cylinder, earthed at its lower end through its root system, would possess a more or less well defined potential node region at or near the intersection of the earth line with the trunk or stem of the tree. Experiment confirmed this, and the point P, at the base of the tree was therefore used, in general, as one of the advantageous points of connection throughout the experiments, and comparisons usually made from this point to others, both up and down the tree itself on the one hand, and in exploring the ground surrounding and adjacent to the tree on the other.

In Figure 1 (c), is shown an arrangement for receiving electromagnetic effects from the surface of the ground itself immediately surrounding the growing tree. Here, as in (b), the point P was a metallic nail in the tree at its base, whereas the point G was at various radial horizontal distance up to and somewhat beyond one-fourth. With this arrangement it was then an object, using P as one terminal, to explore horizontally along the surface of the ground with the other terminal.

It was found that a marked difference in effects could be obtained by changing the point G, relative to the base of the tree, at times even as little as a foot or two, provided, however, it was in a zone beyond six or eight feet distance from P. This minimum distance, however, is a matter of the sensitiveness of the instruments, as well as of the power used at the transmitting station. No law has been observed, thus far, relative to the position of the point G and P, since the local effects produced are quite likely due to the unsymmetrical distribution of the root system immediately beneath the surface, which root system readily conducts electromagnetic waves, and may therefore be considered as an extension of the antenna into the earth.

When the wire at P was entirely removed from the nail at the base of the tree, and inserted in the ground itself immediately adjacent thereto, but not actually touching the tree at all, the signals were heard. Here, then, we are receiving electromagnetic effects without any actual contact with any form of antenna, but directly from the earth itself immediately surrounding the foot of the antenna, and under its electrical influence.

In Figure 1 (a), which is a combination of (b) and (c), is represented a third type of receiving circuit which gave slightly stronger results than either (b) or (c) independently.

With the three typical circuits diagrammatically indicated in Figure 1, a number of experiments were tried, with the following results: Inserting impedance in MN Figure 1 (a) and (b), invariably cut down the intensity of the signals, whereas, impedance inserted in MP (b) and (c), had little or no effect. A large choke coil with an iron core, inserted at the lower contact P of the circuits, made practically no difference, whereas, the reducing influence of a hundred ohms in the branch MN, (a) and (b), was decidedly noticeable. A small air core coil, made by winding a few turns of small wire, and inserted in this branch of the circuit, cut down the effects preceptibly, while seven or eight thousand ohms would cut off all signals. With the arrangement Figure 1 (a), short circuiting from a point at the base of the tree to either side of the microphone, alternately, made no appreciable change in intensity of signals. The detector in use being a microphone, operated by potential difference, and not by energy or current, attempts to increase the effect in the microphone by a number of parallel branches MN, made to several separate metallic pins in the tree around its circumference at the height N,

and joining each to the same terminal of the microphone, produced no perceptible increase in intensity, as was expected. The same may be said, of course, with respect to substituting for the single metallic electrode P at the base of the tree, several such points connected in parallel to the microphone.

Several trees of a large grove were connected in parallel by joining the upper terminals thereof to one terminal of the microphone, the other terminal of the microphone being to earth. Here, again, slight increases were shown upon cutting in different trees in succession, singly, and in combination. The slight difference noticed were probably due to differences in size and character of the trees, the resultant effect upon the microphone being merely that of the most efficient tree of the number being used at any one time.

In an effort to determine means for increasing and concentrating a greater proportion of the electromagnetic waves absorbed by the whole tree system, and for localizing the effect at the proper point in the receiving circuit, the following significant experiment was made.

With the arrangement, Figure 1 (b), several other contacts were prepared around the circumference of the tree at N, and also at P, and these short circuited by wires direct, affording metallic paths for the waves to reach the earth other than the one actually containing the microphone. Not the slightest diminution of the signals could be noticed upon connecting such short circuit wires, either singly or in combination, provided only of course, the short circuit was not between the actual nails used in the receiving circuit, but was confined to other terminals in the tree, even when very close thereto.

This experiment shows that the electromagnetic effects utilized in the single circuit, shown in Figure 1 (b), are but a very small proportion of the total effect absorbed by the whole tree system. This indicates that if we use a wave detector which operates by electrical energy, instead of potential difference, we can easily magnify the effects. Manifestly, this can be done by surrounding the tree, at the selected upper point, by a conducting ring or collar, containing many metallic contacts with the tree itself, thereby multiplying and concentrating at the detector almost at will, the proportion of the energy of the electromagnetic waves absorbed by the tree system as a whole.

In similar manner, the point P, at the base of the tree, may become a conducting ring or collar, with many actual contacts with the tree itself.

If a wire is attached to the same upper tree contact which is being used for receiving, and its other terminal touched in successions to other contacts along the tree nearer and nearer to the lower contact point P of the microphone, then a perceptible decrease in intensity of the signals is noticed as the lower contact P is approached; this operation causes the signals to almost entirely disappear when this wire is touched to the tree within a few inches of the point P. In the latter case, a lower impedance path to earth than that through the microphone is offered the electromagnetic waves.

The point G in Figure 1 (a) and (c), can be made by metallic strips or nets laid upon the ground, or by driving metallic nails or pins into the projecting root system, at sufficient distances from the base of the tree.

The position in azimuth of the contact point N relative to the distant sending station, had no effect upon the received signals, the intensity being the same, even with the points P, N, in an element of the cylinder of the trunk of the tree, on the side directly opposite the sending station.

In Figure 2 (a), is shown an arrangement of transmitting antenna which, however, has been used only over short distances up to the present time, as the experiments thus far have been principally confined to receiving.

In the figure, the earth or ground is made through the root system of the growing tree, and the aerial is merely suspended, using the tree itself as a supporting mast.

Since the capacity of a vertical wire is increased by the presence near it of a conductor parallel thereto, the efficiency of the arrangement can be changed by varying the distance of the vertical wire from the trunk of the tree.

Attempts were made to note if there is any screening effect from neighboring trees in line with the receiving station; in other words, if electromagnetic shadows are cast. With the wave lengths used, and the distances involved, the results seemed equally good from even smaller trees immediately behind a bank of larger ones in line with the transmitting station.

Short circuiting the trunks of trees by direct wires from contacts at a point where the main branches diverge, to a terminal at the base of each, had no appreciable influence upon the signals being received from neighboring trees. A direct current sent through the tree by a hundred volts of battery, when thrown on, off and reversed, showed no perceptible effects upon the signals being received through the microphone.

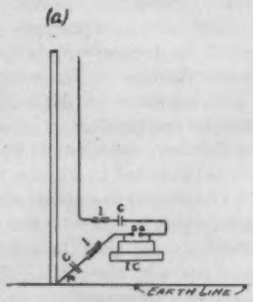


FIGURE 2

No difference in receiving was noticed, resulting from the different wave lengths used in transmitting, whether from the Fort Mason Station, Alcatraz Island Station, or the Naval Station at Yerba Buena Island.

No effects were observed with a telephone in series with a source of electromotive force, and connected directly to two small needle electrodes inserted in the smooth living surface of the inner bark of the tree. This result was expected, but the experiment should be more hopeful if the waves were made to traverse a portion of a minute living hair root, as we would then be dealing with an electrolytic detector built up of vegetable cells.

As indicating the order of magnitude of the ohmic resistance involved in these experiments, it may be stated that in a eucalyptus tree about fifteen inches in diameter, the resistance between two nails fifteen feet apart was about 5500 ohms.

In the cases measured, the resistance circumferentially was greater than that measured over the same distance vertically, or with the grain of the wood.

DETAILS OF FIELD WIRELESS TELEGRAPH RECEIVER

FIELD WIRELESS TELEGRAPH RECEIVER IN SERVICE

In trees possessing a well defined heartwood, the effect of girdling is pronounced, since in such a tree the only living portion is a comparatively thin outer layer, the central portion of heartwood being proctically dea l and free from sap.

In cases of rapid growth, especially in this climate, the whole tree is practically alive, and the effect of girdling, even to a considerable depth, has comparatively little influence on the measured ohmic resistance.

As an example:

In a young eucalyptus tree at the Presidio, San Francisco, eighteen inches in diameter, and about fifty feet high, the resistance was measured between two points on the tree trunk fifteen feet apart, and was found to be 5450 ohms. After completely girdling the tree to a depth of one and one-half inches for a distance of about two feet between the electrodes, another measurement was taken over the same distance, and the resistance was found to be but 6150 ohms.

The efficiency of an elevated capacity area attached to an antenna is not wholly dependent upon the extent of such area, but also upon its general configuration, or in other words, upon its capacity. In like manner, the efficiency of an artifical earth for grounding an antenna does not wholly depend upon the area of the plate buried in the earth, but also upon the shape and disposition of such surface, it having been observed that a given area of earth plate is more efficient in the form of strips, radiating out from a common point, at the foot of the antenna, than in the form of a single circular plate. It appears possible, therefore, that the manifold and varied forms and shapes given by nature to the leaf surfaces of vegetation, adapt them for absorbing electromagnetic radiation; while the general configuration of the root systems of trees, consisting of large radial root trunks, proceeding out from a common stem, and supplemented by innumerable branches and microscopic hair roots and rootlets filled with conducting fluids, is not ill-suited for the conduction of electromagnetic waves into the earth.

Again, the strength required in towers and masts for supporting antennæ wires, is provided in the antennæ here suggested, since a great tree with its natural buttresses, and its root system often extendjng deep into the earth, is well designed to resist the elements.

There is little doubt as present that wireless telegraphy will be used in the military field operations of the future. The maintenance of a wire line has always presented a serious obstacle to reliability aud efficiency. and when this line is in the military terrain, the problem is doubly difficult.

A principal objection to field wireless telegraph equipments has been the necessity of transporting some form of mast, captive balloon or kite, to sustain the vertical aerial. These balloons or kites, in addition to being difficult to manage, also disclose to the enemy the positions of the signal stations.

Realizing the ideal character of some form of space telepraphy for transmitting information in the field, the armies of Europe as well as the signal corps, United States army, have been vigorously investigating this subject.

One of the best military fields outfits at present in use is that furnished by the "Gesellschaft fur Drahtlose Telegraphie" of Berlin, designed by Messrs. Braun, Slaby and Arco. This system has been tested by the signal corps, and there are in operation at present about forty of these equipments in the armies of the various countries of Europe.

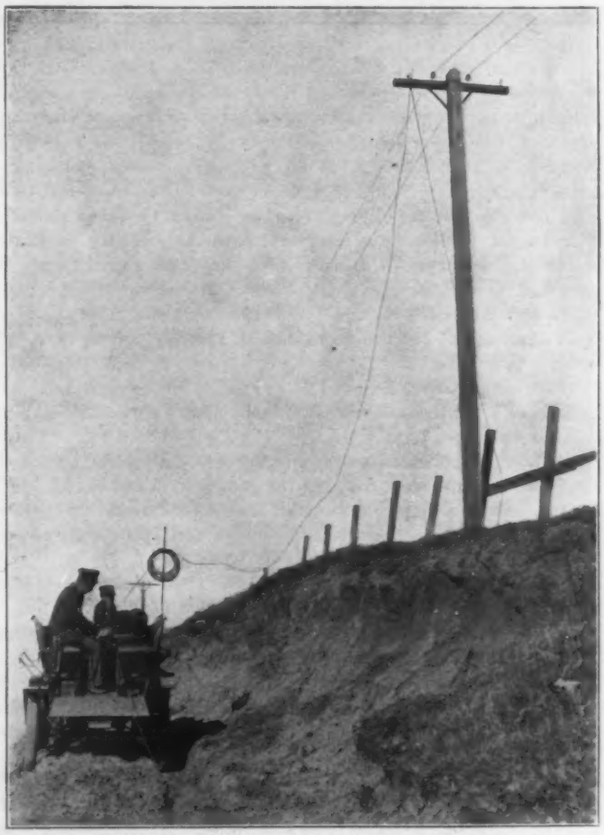
The prime requisities for any field telegraph system are simplicity and reliability.

In the field wireless system above mentioned, there are included a power car, an apparatus car and an implement car. Balloons or kites are used to raise the aerial wires.

The implement car is provided with a gas reservoir, the necessary tools, and a reserve benzine reservoir for the power car.

The power car is equipped with an alternating current dynamo, having a capacity of one kilowatt, and a direct current exciting dynamo coupled to a four horsepower benzine motor. This small engine is cooled by a circulation of water, forced from a reservoir around the cylinder of the engine.

Storage batteries are automatically charged by the continuous



TEMPORARY FIELD WIRELESS TRANSMITTING STATION

DETAILS OF THE FIELD WIRELESS TRANSMITTING AUTO-CAR STATION

current dynamo which supplies current for exciting the alternating current generator.

To the power car is attached the cable drum for hauling in the balloon.

A wire netting or metallic cylinder at a fixed horizontal distance from the earth is used, instead of directly earthing the aerial, in order to give more uniform results for syntonizing.

This general type of apparatus has been furnished the Russian army, and is said to have given good results in the recent maneuvers of the German army. It is also reported to have been adopted by Austria.

The above indicates the comparatively complex apparatus required for field wireless telegraph stations at present.

For short distances, which alone have been thus far attempted for reasons already stated, the field apparatus which was used in some of these experiments, is shown in the photographs herewith attached, indicating how simple the outfit for short distances may become, when the necessity for supporting masts, balloons or kites is removed.

In order to test the other kind of trees than those available at Fort Mason, California, a telegraph auto-car recently purchased for the signal corps of the army, was temporarily fitted with the necessary transmitting apparatus, and a tour made through Santa Clara and Alameda counties, California, installing the operating field sending and receiving stations at various points along the route.

The electric power required was in the form of two small portable storage batteries of ten volts each, which were used to excite a large Apps coil.

When a tree was used to support the sending aerial, the "earthing" was accomplished through the root system of the tree itself, by attaching a wire to one or more iron nails driven into its base. The tree stem was utilized to support the aerial, the only electrical connection therewith being at its base.

For receiving, the apparatus used was that already described and shown in detail in the photograph.

Several kind of trees of various sizes were used for receiving, such as willow, pine, spruce, oak, etc., and a marked difference in efficiency observed. A tree with little leaf surface, and generally dry and unhealthy, is difficult to use at all, even for very short distances, while a tree perfectly dead behaves as an insulator.

After a little practice, two men, a sergeant and a corporal of the signal corps, one a good lineman, and the other the chauffeur of the machine, who also acted as telegraph operator, could install a sending station in ten to fifteen minutes. A receiving station is even less trouble to install, since there is nothing to transport except what can be carried in the hands.

The best field system of wireless telegraphy for the army will result only after careful, tedious and exhaustive experiments, and tests under the exacting conditions of actual war, for the extravagant and enthusiastic claims of inventors have nowhere to be received with more caution than in practical wireless telegraphy.

In the course of these experiments it was desired to measure with a Whitestone bridge, the electrical resistance of living vegetable cells, such as between metallic electrodes inserted in the trunk of a tree.

In attempting such measurements, it became evident that there are electromotive forces present in growing vegetation, which are exhibited in this case by the great difficulty experienced in making any accurate measurements of resistance at all, due to the continued unbalancing of the bridge by these electromotive forces.

The phenomenon is complicated, and considerable experimental care, and many observations upon different kinds of trees, in various locations, and in different kinds of weather, would be needed to clear up the matter satisfactorily.

For instance, unless platinum or other non-oxidizable electrodes are employed, there would be voltaic effects caused by the vegetable acids of the sap of the tree in contact with the metallic electrodes imbedded therein and also, unless modified by the tree itself, we would expect a difference of potential between an electrode at the base of a tree and one higher up the tree, since the upper atmosphere is positive with respect to the earth. Again, it has been shown that a living tree serves as an earthed conductor, and is sensitive to electrical disturbances outside of itself. The resistance measured evidently depends, also, upon the size and shape of the electrodes used, etc.

A suitable electrometer was not at hand, so that in order to determine roughly the general character of these phenomena, some observations were taken with a Weston laboratory standard millivoltmeter, with a diagonal scale capable of indicating electromotive forces as small as .00002 of a volt.

Several curves were taken, but sufficient regularity was not observed to enable any adequate theory to be advanced at present. An electrostatic instrument, whose readings are independent of the ohmic resistance between the electrodes, should be used for such experiments.

The curve, Figure 3, exhibits the volt-time variations observed between two points in the trunk of a eucalyptus tree, one, at the base of the tree, and the other at twenty-five feet elevation. The electrical contacts were made by inserting metallic pins in the tree itself, no earth connections being used.

TEMPORARY FIELD WIRELESS TELEGRAPH AUTO-CAR

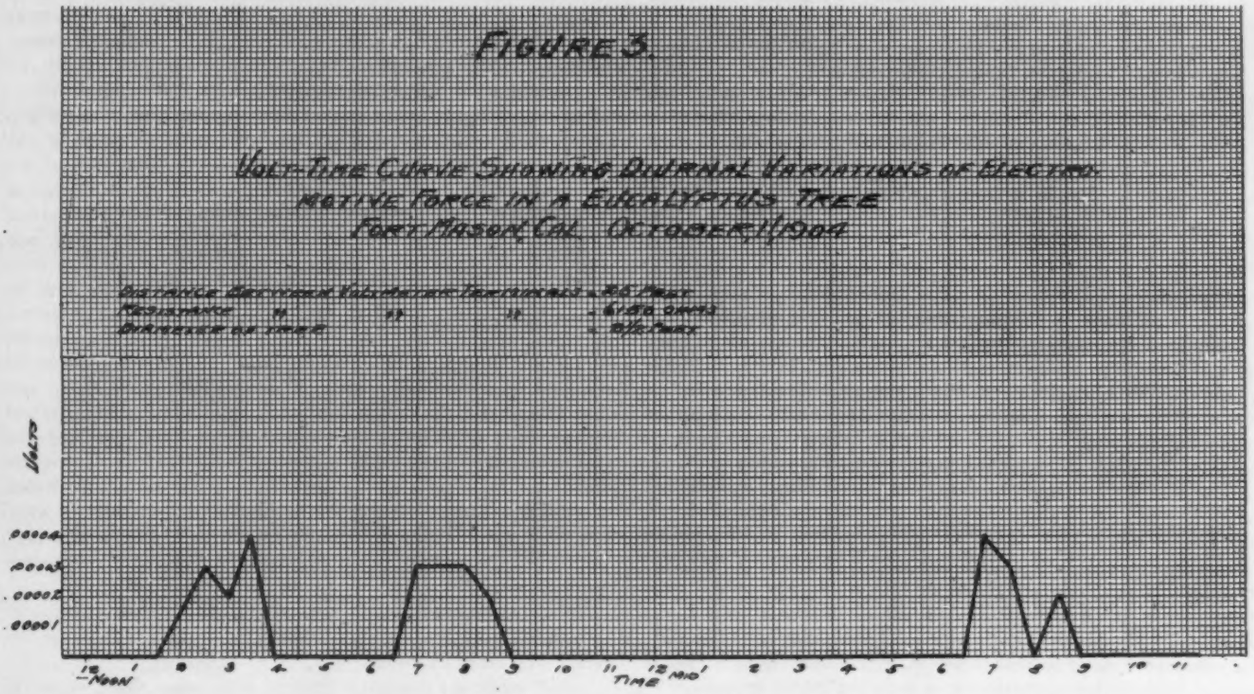
The resistance of the tree between the electrodes was about 6150 ohms, which was large in comparison with that of the voltmeter, and the readings, therefore, do not represent actual values of the voltages, but serve merely to note general diurnal variations in a particular case.

From this curve it is observed that the upper contact is positive with respect to the one at the base of the tree, although slight reversals of very small value, and comparatively sudden changes, evidently due to causes outside the tree itself, were noticed several times. These, however, were too small and too sudden to be read on this scale. The observations for this curve were obtained by half-hour readings over a period of twenty-four hours, during a great portion of which a severe rain storm was raging. The day in general was extremely cloudy, with little sun.

It appears from the curve, that from 9 o'clock in the evening until 6:30 o'clock in the morning, the electromotive force was too small to be recorded by the instrument, and that the principal changes occurred between 6:30 and 9 o'clock in the evening, and between 6:30 and 9 o'clock in the morning, with another rise between 1:30 and 4 o'clock p. m.

FIGURE 3.

VOLT-TIME CURVE SHOWING DIURNAL VARIATIONS OF ELECTRO-MOTIVE FORCE IN A EUCALYPTUS TREE FORT MASON, CAL. OCTOBER 11, 1904.



Variations of the electromotive force between the lower tree terminal and the earth itself, are comparatively large and indefinite in manner, as has been observed frequently before, due to earth currents proper.

In examining the curve in Figure 3, it is interesting to note that two of the maximum changes occurred, one in the early evening, and another in the early morning, about twelve hours apart, or at about the periods when the general influence of the sun during the day is withdrawn for the night, and again when it reappears in the morning after a long period of darkness.

In other cases, the readings between electrodes a short distance apart indicated as much as eight milli-volts, and at times the terminal at the base was positive, instead of negative.

Resistances were more easily measured at night than in the day time, as the balancing of the bridge was then more readily obtained.

According to present theory, during daylight the air is filled with electrons, carrying positive and negative changes of electricity which are more or less recombined during the night.

In this connection, it is interesting to note that it is statad by Sir Oliver Lodge, in a footnote to his Royal Society lecture of 1894, that he found that leaves of geraniums discharge positive electrification five times as quickly as negative, under the action of an arc light.

Evidently, these phenomena require careful investigation.

There are three modes by which an electrical disturbance may be transmitted through space, namely:—by electromagnetic induction, by electrostatic induction, and by electromagnetic radiation.

The first of these was the basis of an early system of wireless telegraphy, as used by Sir William Preece and others. The second comprises a method proposed by Professor Dolbear,* Edison, and others.

In general, the effects of both electromagnetic induction and electrostatic induction decrease with the cube of the distance from the source, so that these methods have not proved efficient as a means of transmitting intelligence through space where considerable distances are involved.

Since Hertzian waves are readily absorbed by vegetation, it was desirable to determine to what extent electromagnetic oscillations of low frequency are also absorbed. The following experiment was therefore tried:

Near Lorin Station, along the route of the long distance transmission line of the California Gas and Electric Corporation of San Francisco, the vegetation was examined for inductive effects. This line transmits power from Yuba County, California, at a voltage of 56,000, with a frequency of sixty cycles per second, three-phase.

From previous experiments, it was thought that the vegetation in the vicinity of this transmission line would be sufficiently affected, so that a note corresponding to this frequency would be heard in a telephone receiver.

Upon connecting the telephone between two nails driven in any growing tree along the route of this line, and at a reasonable distance therefrom, the telephone responded to this note with great clearness, and when the distance was not more than 100 feet, the sound was very loud. For this experiment, no microphone need be used, nor any source of electromotive force other than that induced in the tree itself, the telephone being connected directly between two nails driven into the tree.

Since the trunk or stem of the tree, being perpendicular to the

*U. S. Letters Patent No. 350,299, dated October 5, 1886.

surface of the earth, is normal to the direction of the transmitting wire, the effects of electromagnetic induction should be a maximum between points of the tree on a line parallel to the wire, and a minimum between points on a vertical line. Since, however, the large leaf surface at the top of the tree presents in reality an extensive conducting area, it may be regarded as having a resultant surface which acts as a capacity plate parallel to the earth, and connected therewith by a vertical cylindrical conductor represented by the stem or trunk of the tree. The details of the experiment follow:

In a tree eighteen feet in diameter, between points in the circumference at the same level above the surface of the earth, and parallel to the wire, the effects were nil in the telephone, whereas, the effects in a vertical line along the trunk of the tree increased in general with the distance between the electrodes. It appears, as stated above, that, although the stem of the tree is normal to the power line, the general leaf surface spreads out horizontally, and receives electrostatic charges from the alternating current in the line, causing a corresponding alternating current to flow in the trunk of the tree, which current is indicated in the telephone.

Opposite the transmission line, in an open meadow free from vegetation, an examination of the surface of the ground with the same apparatus exhibited marked effects, and with one terminal stationary, and the other terminal exploring in azimuth, the location of the equipotential lines, normal to the direction of the wire, and of the lines of current flow, parallel thereto, could be readily and accurately traced at any reasonable distances from the wire, the effects, however, rapidly dying away as the lateral distance increased.

The points of no sound in the telephone could be located within two or three feet, at a distance of one hundred feet from the transmission line, and with no source of electromotive force other than that induced in the surface of the earth. This simple experiment is very realistic, and is a repetition on a large scale of the familiar laboratory experiment of tracing the lines of current flow on the surface of a conducting liquid by means of a telephone and "buzzer," except that in the latter case we are concerned with electric conduction instead of electromagnetic induction.

Several kinds of trees of various sizes and forms were examined along this power transmission line, and all were found to be singing, with a loud voice, the fundamental note characteristic of the frequency of the line current. Indeed, the strip of vegetation along this line has thus been singing continuously, day and night, for several years, since the operation of the line began, it needing only the electromagnetic ear to make the sound appaaent.

The general appearance of vegetation along this route is certainly vigorous, showing that the continuous presence of actual electric current of an oscillation character, flowing throughout the living portion of the vegetation, does not apparently interfere with normal growth—indeed, if any effect is noticeable, it is rather that of increased luxuriance of growth in the immediate vicinity of this line, although this point would require careful observation by skilled specialists. The fact remains, that from a botanical standpoint, we have here an experiment on a huge scale of vegetation growing over an extended period of time under the influence of induced electrical oscillations of low frequency flowing through its living parts.

This transmission line, at the point examined, is strung on wooden poles about forty-five feet in height, with special porcelain insulators for the excessive voltages used. The insulation is so effective that an examination of one of the supporting poles of this line, in the same vicinity, and with the same apparatus, failed to give any indication in the telephone, although the pole itself was vibrating mechanically, due to the stretched wire being supported on it. In fact, dead vegetable matter, thoroughly dry and free from sap, is an efficient insulator for electrical oscillations.

The conductivity of a substance for electrical oscillations of high frequency is dependent upon the amount of surface area, rather than upon the volume, since the result is a "skin" effect, which decreases in thickness as the period of oscillation increases. The amount of conducting area presented in the innumerable chains of vegetable cells filled with conducting fluids, which go to make up the living portion of the trunk of an ordinary tree, is very great compared to that offered by wires.

Spectrum analysis has been of inestimable value in making known to the world the manifold beauty and variety of radiation, and it stands at present as the most powerful means at the disposal of the physicist and chemist for qualitative analysis.

This method has revealed the existence of many until recently so-called elements of nature, such as caesium, rubidium, thallium, indium, gallium, etc., and is able to detect, under proper conditions, the presence of such a very minute quantity of a substance as one ten-millionth of a milligram of calcium, and a one hundred-millionth of a milligram of strantium, in the high temperatures of the electric discharge. Heretofore, spectrum analysis has not been available for studying vegetable matter.

If in the place of the usual metal electrodes of a moderately powerful induction coil suitable vegetable electrodes be substituted most of the phenomena of the electrical discharge in air can be observed. An instructive experiment is the following:

Place upon a glass table two ordinary house plants in earthen jars, preferably plants of large leaf area, such as those of the palm family. Separate the regular secondary terminals of the coil beyond the sparking distance, and connect the two growing plants each to a secondary terminal by simply inserting a fine wire in the damp soil in the jar, without actual contact with any part of the plant itself. Darken the room and excite the coil. By placing the jars near together, and then separating them by sliding them along the table, interesting phenomena are observed. When the nearest leaf surfaces of the two vegetable electrodes are beyond the disruptive sparking distance, the brush discharge effect outlining the edges of the various leaves if beautiful, and exhibits the effect of points and edges in streamlets of purple and lavender discharge. As the jars are moved nearer together, the usual disruptive spark takes place, and at a distance so nearly equal to the regular sparking distance between metal electrodes, that the living leaves of the plants may be said to behave electrically, for these highly oscillating currents, as though they were sheets of metal of the shapes and dimensions of the leaves themselves.

Under proper conditions, from a normal eight-inch spark coil, a six-inch disruptive spark of deep purple is readily obtained between vegetable electrodes.

Upon closing the primary circuit of the coil, a decided movement of the leaves and stems of each electrode is observed, depending upon the stiffness of the leaves themselves, or their resistance to mechanical stress. The individual leaf surfaces of the same electrode suffer a mutual repulsion, while the leaves of opposite electrodes are strongly attracted, and may move up toward each other an inch or more at the moments of disruptive discharge.

These comparatively large leaf areas act as charged condenser plates of metal, those whose charges are of the same sign repelling each other, while those of opposite sign attract. The general effect of the electrical oscillations upon the plant life itself is interesting, and should be investigated quantitatively. When the discharge is a powerful one from a large coil, and the plant surface is small, the leaves between which the disruptive discharge take place, seem to dry up and die within a day or two after such an experience, whereas other stems of the same electrode, on the side away from the disruptive discharge, remain seemingly unaffected, and continue to grow apace.

The heat of the discharge, and the volatilization of the water in the plant, undoubtedly play an important part, but what effect these rapid electrical oscillations may have on the living protoplasm of the plant cell, is an important question. The above indicates that in plant life, as in living animal cells, weak electrical oscillations may stimulate without harm, while sufficiently strong ones may produce "electrocution."

Since it is known that the red end of the solar spectrum contains the more efficient electromagnetic waves involved in plant growth, may not much longer electromagnetic waves, even such as those being here considered, which we have some reason to believe are also radiated by the sun, be capable of influencing plant life under suitable conditions?

For spectroscopic work, the discharge should be one of considerable energy, and for this purpose one or two Leyden jars in parallel with the spark gap, can be used to advantage, by which means the character of the spark may be changed from a thin non-luminous one, to a short, thick spark of greater brilliancy.

The general shape of a leaf surface causes the discharge to take place from its points and edges, thus dissipating the effect, but this can be partially overcome by "forming" the vegetable electrodes in suitable insulating and adjustable dies, such as by forcing several leaves, unattached from their growing stems, into glass tubes, so that their inner ends to which the discharge is thus confined, will present vegetable surfaces of definite form. Comparatively large electrical power is needed for success in such experiments.

In Figure 4, are shown photographic spectra recently taken at the University of California, at Berkeley, California, between dandelion and ivy electrodes, respectively. These were kindly

All lines and bands other than sodium lines appear to be due to nitrogen, and carbon compounds, and water vapor

FIGURE 4

furnished by Professor Percival Lewis, of the department of physics, of the University, a well known authority on spectroscopy.

Until recently, the vegetable kingdom has been regarded as practically non-electric, but due to exhaustive researches* into the natnre of the discharge of electricity through gases, the discoveries following that of radio-activity, etc., a new electric theory of matter has been formulated, which serves to bring all forms of gross matter within its comprehensive embrace.

It would seem that living vegetation may play a more important part in electrical phenomena than has been generally supposed. We have seen that living vegetable organisms absorb and conduct electromagnetic oscillations over a wide range of the electromagnetic spectrum, beginning with sunlight, whose electrical action in the plant cell is at present little understood, and extending the waves of identical character, but of immensely greater lengths, such as Hertzian radiation, telephonic waves, and oscillations of the ordinary low frequencies used in commercial electric transmission lines. Disruptive discharges between vegetable electrodes, and electrostatic effects between vegetable surfaces are easily produced. The paucity of scientific literature upon this general subject is remarkable.

Recently, Professor S. Lemstrom† of Helsingfors, Finland, published an occount of some interesting experiments upon vegetable growth in northern latitudes.

It is noted by Professor Lemstrom that there is a rich development of plants in the Polar regions, as compared with corresponding conditions in countries further south, which he attributes to peculiar electrical conditions of the atmosphere causing the phenomena of "aurora borealis."

It is also noted that the flora of the Temperate and Polar regions, such as the pine and fir, have by nature sharp pointed foliage and pointed projections, suitable for the conduction of electromagnetic waves accompanying "aurora borealis."

May not here exist either a cause of, or in part, a reason for, such floral forms?

Plowman* has studied the growth of seedlings in water through which an electric current is made to flow, and records the general effect of the anode in causing the root tips to turn towards it. He attributes this reaction to the effect of positive electrons rather than to mere chemical effects of the atoms themselves, and states his conclusion that "negative charges paralyze the embryonic protoplasm of plants."

Since it is easy to induce into plant cells electromagnetic oscillations over a wide range of frequency without mechanically disturbing the natural position of the plant in soil, researches to determine the possible influence of such oscillations upon plant life should be undertaken.

According to present theory, all electrical conduction is really electrolytic in character, accompanied by dissociation of electrons and recombination, so that actual oscillatory currents maintained throughout the living organisms of vegetation may effect changes in a growth whose very existence is now known to vitally depend upon other electromagnetic waves of sunlight.

Heald† has examined, for the determination of relative electrical conductivity, the juices of plants, expressed from the leaves, stems, roots, etc. He finds such juices comparatively good conductors, due principally to dissolved mineral substances, while organic compounds play a minor part.

Jonesco‡ has given elaborate study to the underlying causes of the seeming preference of lightning for certain kinds of trees, and states that woods rich in fatty materials are not as good conductors as those containing a greater proportion of starchy matter.

The element of imagination is a dangerous one in physical research, yet without it, often in a bold form, the more important advancements in physical science would not have been made.

However, in view of what has been accomplished in space-telegraph within the last seven or eight years, it is difficult to predict to what extent this means of communication may be ultimately developed. If, as indicated above in these experiments, the earth's surface is already generously provided with efficient antennæ, which we have but to utilize for such communication, even over short distances, it is a fascinating thought to dwell upon in connection with the future development of the transmission of intelligence.

Since a transmitting station is a central point for electromagnetic waves sent out in all directions over the surface of the earth, a large class of information, such as meteorological reports, crop reports, and general news items of interest to all, may in time be sent from central points, to be received at many places within the radius of influence of the signal station, and this, too, by the simplest forms of apparatus.

Again, it is seen that a growing tree, covered with foliage, is influenced inductively by electrical disturbances outside of itself, and in fact becomes generally responsive to induced electrical oscillations. It should offer, therefore, a promising means of studying meteorological effects of an electrical character, particularly those of lightning discharges, and electricity of the air. One of the first practical rules for the preservation of life against lightning is to avoid the vicinity of a tree.

*"Conduction of Electricity through Gasses," J. J. Thomson.

†"Electricity in Agriculture and Horticulture," by Professor S. Lemstrom, London.

* "Electrotropism of Roots," by Amon B. Plowman, Phanerogamic Laboratories, Harvard University, *American Journal of Science*, August, 1904, ibid XIV page 131. August, 1902.

† "The Electrical Conductivity of Plant Juices," Frederic De Forrest Heald. *Science*, Volume 15, Page 457.

‡ "Ursachen der Blitzschlage in Baume, Dimitrie Jonesco, Stuttgart, 1892

Our great forest areas may exercise an influence in maintaining a general equilibrium between the electrical charges of the upper atmosphere and the earth, which has not been fully realized. On this point, comparisons between observations from the interior of great desert areas devoid of any vegetation, with those from other portions of the earth's surface well covered with forests, would be instructive.

Notwithstanding the accumulated data since the famous kite experiment of Franklin in 1752, much has yet to be done towards an electrical survey of the earth's atmosphere.

From this viewpoint, the general surface of the earth may be considered as supplied by nature with innumerable meteorological observation towers, which possibly may be employed by means of apparatus involving principles already well known to science.

In conclusion, it is believed that vegetation should be studied more systematically from a distinctly physical standpoint than has been done in the past. Physics has been said to be the mother of all the sciences, and more and more the physical method of studying all science is proving to be the true one, as is evidenced by the great advance in recent years in comparatively new branches of scientific work, such as astrophysics and physical chemistry. Has not the time arrived for a more systematic study of physical botony, in the light of the new electric theory of matter?

LITERATURE.

"STATE AND TERRITORIAL GENERAL STATUTES RELATING TO THE USE OF STREETS AND HIGHWAYS BY STREET RAILWAY, GAS, WATER AND ELECTRIC LIGHT COMPANIES." Complied by James S. Cummins and published by H. M. Byllesby & Co., engineers, New York Life Building, Chicago, 1905. Cloth binding, with 268 pages, nine by six inches in size.

A succinct digest of the general statutes of the various states and territories of the Union, pertaining primarily to the franchise rights of quasi-public corporations thereunder, is here presented by a prominent Chicago lawyer whose practice of fifteen years and more in connection with the incorporation of such institutions, and the passing upon their franchise rights, has clearly indicated to him the course to follow in the compliation of a work of this character. The result is that evidently the book is as complete as it is possible for a specialist to make it, moreover it is up-to date. The author states in the preface that he has frequently found that much unnecessary preliminary expense has been incurred through ignorance on the part of business interests on the subject of the fundamental laws governing the issuance of franchises, whereas a preliminary reference to such laws would have shown at once that the franchises in question were invalid or doubtful. The present work constitutes such a compendium, and although it was the original intention of the author to compile it for the use of his clients, it has now been made universal so far as the general laws throughout the United States are concerned. In all probability the present work will be followed by subsequent treatise covering the principal decisions in the franchise litigations that have arisen in recent years, together with a discussion of their bearing on the general subject.

Undoubtedly the best presentation of the character and scope of the present work will be given by a reproduction of that portion of it pertaining to the general statutes of a particular state. Under the heading of "California," for instance, there appears the following;

CALIFORNIA.

CONSTITUTION.

Section 21, Article 1. No special privileges or immunities shall ever be granted which cannot be altered, revoked or repealed by the Legislature, nor shall any citizen or class of citizens be granted privileges or immunities which, upon the same terms, shall not be granted to all subjects.

Section 25, Article 4. The Legislature cannot grant to any corporation, association or individual any special or exclusive right, privilege or immunity.

Section 33, Article 4. The Legislature shall pass laws for the regulation and limitations of charges for services performed and commodities furnished by telegraph and gas corporations, etc.

Section 11, Article 11. Any county, city, town or township may make and enforce within its limits all such local police, sanitary and other regulations as are not in conflict with general laws.

Section 19, Article 11. In any city where there are no public works owned and controlled by the municipality for supplying the same with water or artificial light, any individual or company duly incorporated for such purpose, under and by authority of the laws of this State, shall, under the directions of the superintendents of streets or other officers in control thereof, and under such general regulations as the municipality may prescribe for damages and indemnities for damages, have the privileges of using the public streets and thoroughfares thereof and of laying down pipes and conduits therein and connections therewith so far as may be necessary for introducing into and supplying such city and its inhabitants either with gas light or other illuminating light or with fresh water for domestic and all other purposes, upon the condition that the municipal government shall have the right to regulate the charges therefor.

Note—The courts have held the word "city" means and includes towns (129 Cal. 397; 62 Pacific 61; 62 Cal. 209; 119 Cal. 30).

Section 10, Article 12. The Legislature shall not pass any laws permitting the leasing or alienation of any franchise so as to relieve the franchise or property held thereunder from the liability of the lessor or grantor, lessee or grantee contracted or incurred in the operation, use or enjoyment of such franchise or any of its privileges.

Note.—See 116 Cal. 97; 47 Pacific 932.

Section 1, Article 14. The use of all water now appropriated or that may be hereafter appropriated for sale, rental or distribution is hereby declared to be a public use and subject to the regulation and control of the State, provided that the rates or compensation to be collected by any person, company or corporation in this State for the use of water supplied to any city and county or city or town or the inhabitants thereof shall be fixed annually by the Board of Supervisors for city and county or city or town, council or other governing body, etc., by ordinance or otherwise, in the manner the other ordinances or legislative acts or resolutions are passed and shall continue in force for one year and no longer. Such ordinance shall be passed in the month of February of each year and take effect on the first day of July thereafter.

Note.—See 62 Cal. 209; 74 Cal. 571; 82 Cal. 286; 24 Supreme Court Report 586; 116 Cal. 97; 47 Pacific 932.

Section 9, Article 20. No perpetuity shall be allowed except for eleemosynary purposes.

FRANCHISES.

Act of 1903, page 90, Section 1. Every franchise or privilege to erect or lay telegraph or telephone wires, to construct or operate street railroads upon any public street or highway, to lay gas pipes for the purposes of carrying gas for heat and power, to erect poles and wires for transmitting electric heat and power, along or upon any public street or highway or to exercise any other privilege whatever, hereafter proposed to be granted by Boards of Supervisors, Board of Trustees, Common Council or other governing or legislative bodies of any city and county, city or town within the State, except steam railroads, telegraph or telephone lines, are acquired as follows:

Section 2. Application therefor must be made to the proper authorities and by them advertised that bids would be received for such franchise and that it would be awarded to the highest bidder.

Section 3. The publication must state the character of the franchise, the term for which it is granted and that the successful bidder must during the life of said franchise pay to the municipality 2 per cent. of the gross annual receipts. However, no percentage shall be paid for the first five years succeeding the date of the franchise, but thereafter such percentage shall be paid annually, and for any default of the payment thereof the franchise may be forfeited, and it is further provided that if the franchise be a renewal of a right already in existence, the payment of the said percentage shall begin at once.

Section 4. In case the franchise granted shall be an extension of an existing system of street railroad then the gross receipts shall be estimated to be one-half of the proportion of the total gross receipts of said system which the mileage of such extensions bears to the total mileage of the whole system, and said estimate shall be conclusive as to the amount of the gross receipts of said extension.

Section 5. The franchise shall be awarded to the highest bidder.

Section 6. Work shall be begun within not more than five months from the granting of the franchise, and if not commenced

within that time, said franchise shall be declared forfeited and shall be completed within not more than three years thereafter, and if not completed within such time said franchise shall be forfeited.

Section 7. The authorities shall require a bond to be filed for the faithful performance of the contract.

Act, February 25, 1905. This Act ratifies all ordinances heretofore granted to street railways to propel cars by electricity

Civil Code, Section 497. Street railway franchises shall not exceed fifty years.

Act, February 24, 1893.—Civil Code, Section 773. A franchise for a street railway or an extension thereof cannot be granted within ninety days preceding a general election or within seventy days next following the general election.

Street railways are authorized and required to carry mail carriers without fare while in discharge of their duties.

Political Code, page 1023. Section 440. A city or town cannot grant a franchise for water or gas for a term exceeding twenty-five years.

Political Code, Article 3. Section 764. A municipality having a population of not more than 10,000 has the power to construct water works, electric and other plants for supplying the city with water and electric or other lights and the right to purchase, lease or construct water works, electric plants, gas plants and to supply said city with and to sell to the inhabitants thereof, water, light, heat and power provided the question of acquiring such property is submitted to the voters, and a majority of the voters favor same.

Cities of over 100,000 inhabitants have the right to provide for lighting the streets, but no contract for lighting streets or public buildings shall ever be made for more than one year nor shall any contract be made to pay more for gas or other illuminating material than is legally charged to ordinary consumers or than the usual rates charged under like conditions.

Without reason there seems to be some distinctions shown by the several acts as they do not empower all of the cities and towns the same rights to acquire or construct such plants or to contract for light and water. The constitution and statutes indicate that perpetual and exclusive franchises cannot be granted.

The use of streets for water, gas or street railway purposes cannot be made so as to alienate or impair the power of the city to grade, sewer, pave, macadamize or otherwise make, alter or repair the streets or highways.

The Act of 1901 as to water, electric light and gas companies is in violation of Section 19 of Article 11 of the constitution, which grants the privilege to such companies to use the streets in cities and towns without the consent of the authorities thereof.

In any city where there are no public works owned and controlled by the municipality, electric light, gas and water companies are not required to get the consent of municipalities and such company is only required to construct and operate subject to the direction of the superintendent of streets or other officer in control thereof and under such regulations as the municipality may prescribe. Pereria v. Wallace, 129 Cal., 379; In re Johnson, 137 Cal., 115; People v. Stephens, 62 Cal., 209; Mutual Electric Company v. Ashworth, 118 Cal., 1.

It would seem under this constitutional provision that the life of a franchise of electric, gas and water company would be for its life as a corporation.

No information concerning the price of this work is at hand but its character is such as to imply its distribution among the clients of Messrs. H. M. Byllesby & Co., of Chicago, and who are engineering for the design, construction and operation of railway light, power, hydraulic and gas plants.

THESES ON ELECTRICAL ENGINEERING AT LEHIGH.

CANDIDATES for the degree of electrical engineer, to be issued by the Lehigh University, of South Bethlehem, Pa., will present subjects for theses during the month of June, as follows:

Louis Frederick Blume (with S. H. Fleming), Philadelphia, "An Investigation of the Polarization Factor of Electrolytic Cells."

Charles Ely Butz (with G. H. Schaeffer), Allentown, "An Investigation of the Power Required to Drive Machine Tools."

Douglas Meeker Clawson (with C. E. Clewell), Mt. Vernon, N. Y., "A Report on the Present Conditions and Proposed Improvements of the Bethlehem and Nazereth and of the Slate Belt Electric Railway Systems."

Clarence Edward Clewell (with D. M. Clawson), Winston-Salem, N. C., "A Report on the Present Conditions and Proposed Improvements of the Bethlehem and Nazereth and of the Slate Belt Electric Railway Systems."

Paul Cloke (with N. E. Funk), Trenton, N. J., "A Theoretical and Experimental Study of a Seven-and-one-half-Horsepower Induction Machine as a Motor and a Generator."

Samuel Henry Fleming (with L. F. Blume), Philadelphia, "An Investigation of the Polarization Factor of Electrolytic Cells."

Nevin Elwell Funk (with P. Cloke), Bloomsburg, "A Theoretical and Experimental Study of a Seven-and-one-half-Horsepower Induction Machine as a Motor and a Generator."

Cameron Douglass Hayes (with E. V. Phelps), Belair, Va., "Tests of the Performance of a Six-Light General Electric Constant Current Transformer."

George Stickle Mervine (with J. H. Wily), Philadelphia, "An Investigation of the Commutating Conditions in Single-Phase Commutator Motors."

Thomas Benjamin Mickley (with H. W. Protzeller), Ballietsville, "Tests on the Comparative Behavior of Two Types of Induction Motors when Operated on Single-Phase and Two-Phase Circuits."

Earl Victor Phelps (with C. D. Hayes), Washington, D. C., "Tests of the Performance of a Six-Light General Electric Constant Current Transformer."

Harry Weiser Protzeller (with T. B. Mickley), Hokendauqua, "Tests on the Comparative Behavior of Two Types of Induction Motors when Operated on Single-Phase and Two-Phase Circuits."

Edwin Louis Rich (with R. H. Smith), Washington, D. C., "An Investigation of the 'Over Voltages' in Electrolysis."

George Henry Schaeffer (with C. E. Butz), Reading, "An Investigation of the Power Required to Drive Machine Tools."

Richard Hendon Smith (with E. L. Rich), Philadelphia, "An Investigation of the 'Over Voltages' in Electrolysis."

James Hunter Wily (with G. S. Mervine), Pughton, "An Investigation of the Commutating Conditions in Single-Phase Commutator Motors."

ELIMINATION OF CARBON FROM CHECKER BRICK.

BY R. H. STERLING.

IN the crude oil gas works of the Watsonville Gas and Electric Company, it has been found that to eliminate carbon deposits in checker brick, burning zinc in the generator is a most useful substance. This has long been known as an excellent substitute for a chimney sweep, though on first thought it would strike one as being rather an expensive article to use in a gas generator for this purpose, but any quantity of old dry-cell batteries can be had from telephone companies, who are glad to get rid of them for the hauling away and the outer shells of these are pure sheet zinc. A few of them, just as they are, are thrown into the generator occasionally and as a result no trouble is ever experienced with carbon deposits on the checker work.

TELEGRAPHING IN JAPANESE.

The Japanese, like the Chinese, have no alphabet in the ordinary sense, every word in their written language being represented by a separate character. In telegraphing in these languages, therefore, about 10,000 words are selected, and figures ranging from one up to 9,999 are allotted to each word. Each word of a message to be transmitted by telegraph in these languages is then first given its proper number by the telegraph clerk, by means of a dictionary which has been prepared under the authority of the government. These numbers are then transmitted by the Morse alphabet, and when received the message is translated back into the Chinese or Japanese characters by reference to a corresponding dictionary.

TECHNICAL ADVERTISERS ORGANIZE.

The advertising representatives of a large number of concerns engaged in the manufacture of machinery and allied industries have formed an organization, to be known as the Technical Publicity Association. The first annual meeting, dinner and election of officers will be held in the rooms of the Hardware Club, in the Postal Telegraph Building, New York City, on the evening of April 27th, when an address will be delivered by E. T. Harris, well known as a broker of trade and technical journals.

The Journal of ELECTRICITY, POWER and GAS
DEVOTED TO THE CONVERSION, TRANSMISSION and DISTRIBUTION OF ENERGY.

PUBLISHED MONTHLY BY
The Journal of Electricity Publishing Company
Room 582, Rialto Building, San Francisco, Cal.
Telephone Main 1264.

Official Organ of the Pacific Coast Electric Transmission Association.

Yearly subscription: Domestic, $2.00; Foreign, $3.00; Single Copies, 25 cents.
Subscriptions can not be begun with back numbers.
Manuscripts submitted must be accompanied by postage to insure return.

ADDRESS ALL COMMUNICATIONS AND MAKE ALL REMITTANCES PAYABLE TO THE JOURNAL OF ELECTRICITY PUBLISHING COMPANY

This paper is a member of the National Trade Press Association.

Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as *The Electrical Journal*, July, 1895. Entry changed to *The Journal of Electricity*, September, 1895.

VOLUME XV JUNE, 1905 NUMBER 6

EDITORIAL.

A GENERAL ENGINEERING CONGRESS

Never have circumstances prognosticated more auspicious events for the Pacific Coast Electric Transmission Association than those of the present which foretell a most successful convention from every viewpoint, be it from that of the excellence in papers to be presented, the thoroughness of discussion which follows them, the benefits to accrue from broad fraternizations on the part of those who are prominent representatives of interests thoroughly in communion with each other, or the recreation to be found in visiting not only a great exposition of unusual merit but, as well, in touring a locality which abounds in engineering triumphs that figuratively are as imposing as the natural grandeur of the country in which their scenes are laid.

As forecasted in these columns last month, the Executive Committee of the Transmission Association has carefully considered the expediency of holding its Ninth Annual Convention in conjunction with the Pacific Coast Engineering Congress to be held at Portland, Oregon, on June 29th and 30th. This Congress, which was called conjointly by the Pacific Northwest Society of Engineers of Seattle, Wash., and the Technical Society of the Pacific Coast of San Francisco, is also to be held under the auspices of the Lewis and Clark Centennial Exposition, and to it all engineers and other technical men are especially invited. A goodly number of papers to be read at the Congress have been prepared by members of the various engineering societies which have become affiliated with the Congress, notable among which in addition to the societies named are the Montana Society of Engineers, the Pacific Coast Railway Club, and the Pacific Coast Electric Transmission Association. With the single exception of the Transmission Association the societies that are identified in the Congress regard it in the nature of a special session: but with the Transmission Association such is not possible without reservation, for the reason that under its constitution the annual convention cannot be dispensed with, nor is it advisable to consider so doing. The affiliation of the Transmission Association with the Congress will therefore be merely that of a simultaneous session held coincidently with the Congress, but independent of it except that the Association will convene with the Congress during its introductory exercises, after which it will adjourn to its own meeting place for the transaction of its own business. As a number of papers of interest to the delegates to the Transmission Convention will be read and discussed before the Congress, the Convention may adjourn temporarily to the chamber of the Congress whenever it may be advisable for it to do so.

As yet the papers to be presented to the Congress for discussion have not been definitely determined upon, but it is probable that among the topics to be considered will be the following:

"Concrete Steel in Chimney Construction—Describing a Three Hundred-Foot Stack."

"The Cazadero Hydro-Electric Plant of the Oregon Water Power and Railway Company."

"Government Improvements at the Cascades of the Columbia River."

"Improvements at the Mouth of the Columbia River by the United States Engineers."

"Irrigation Papers by the Officials of the United States Geological Survey's Department of Irrigation."

The above papers at least are promised by the Northwestern Society, and in addition thereto the Technical Society will submit several papers, prominent among which are the following:

"Reinforced Concrete," by Lewis A. Hicks.

"Pacific Coast Industrial Engineering Problems," by George W. Dickie.

"Timber Tests; Methods and Results," by Loren E. Hunt.

"The Principles Governing the Valuation of Water Works Under Private Ownership," by Arthur L. Adams.

"The Struggle for Water in the Great Cities of the United States," by Marsden Manson.

"The Debris Restraining Dam of the Yuba River," by Captain W. W. Harts, U. S. A.

"Subterranean Water as found in the Valleys of California," by John Richards.

Other papers have been suggested, and there will undoubtedly be further subjects of paramount interest brought up for general discussion.

In due course of time notices will be issued to members of the Transmission Association in announcement of the programme to be followed during its Convention, but at present it is impossible to detail them. Among the

topics which in all likelihood will come up for discussion through papers will be those on the adaptability of gas engines in large units for driving electric generators: on the Cedar River plant of the city of Seattle, with special reference to its economies of cost, operation and technical performance; on the steam turbine and transmission system of the Lewiston-Clarkston Company, discussed from the same standpoints; on the new hydro-electric development of the Portland General Electric Company; on the physical influences of long span high tension transmission line construction; on European practices in the use of electricity for the reduction of iron ores; and on the commercial organization of quasi-public electric corporations, and on the cost of electric power in irrigation. In addition the editors of the various Association departments, namely, those of the Progress Editor, the Question Box, and the Wrinkle Department, each promise to be on hand with a well filled knapsack of experience and information. Other papers will also be forthcoming, so that there will be no lack of material for deliberation and digestion.

The Congress programme as now planned, and which in point of hours will be generally adhered to the conduct of the Transmission Couvention, contemplates assembling in the parlors of the "American Inn" which has been selected as the headquarters of both the Congress and the Convention. The introductory exercises will consist of an opening address of welcome and a general reception, which will take place between the hours of ten o'clock and noon of Thursday morning, June 29th. At two p. m. of the same day the afternoon session will begin, to continue until 4:00 p. m. The same hours will be observed for the transaction of business on the following day, Friday June 30th, and at 4:00 p. m. of that day the regular members of the Transmission Association will go into executive session for the transaction of its usual business including the election of officers to serve during the ensuing year. The Transmission Convention will undoubtedly conclude its labors on Friday afternoon, and if the usual procedure is followed the annual banquet will be held on the evening of that day. On Saturday July 1st, the attendents to the Congress and Convention will make an excursion by special steamer up the Columbia River to the Cascade Locks and Celilo Canal where the works of the engineers of the United States Government will be inspected. This trip will be a most thoroughly enjoyable one because of the renowned grandure of the scenery of the Columbia River—scenery which is awe-inspiring and sublime. Those who care to do so will, on the following day (Sunday), make an excursion down the Columbia River to Astoria in order to visit the jetty improvements at the mouth of the river which have been effected by the Government engineers. Both these Columbia River excursions will be given under the auspices of the Government engineers in charge of the Columbia River improvement. On Monday, July 3rd, there will be an excursion by special boat up the Wilamette River to Oregon City to visit the great hydro-electric power plants there being constructed and operated by the Portland General Electric Company. These are at the famous Falls of Willamette, and the installation is not only of great commercial but of exceedingly important historical interest. At Oregon City the party will be turned over to the officials of the Oregon Water Power and Railway Company and taken thence by its superb electric railway line to its Cazadero plant, located a distance of about thirty miles up the Clackamas River, and where there is being constructed a great dam and hydro-electric plant that will partially supplement the water power development of the Portland General Electric Company.

At this point the excursions that have thus far been arranged for the Congress will terminate, but unless plans miscarry the attendants to the Transmission Convention will have further entertainment provided in the way of a trip to Puget Sound region. In this event the delegates will possibly be invited to become guests of The Seattle-Tacoma Power Company and The Platt Iron Works Company for a visit to the famous Sonoqualmie Fall plant,* and the next day upon their return to Seattle, The Seattle Electric Company will extend the courtesy of an excursion from Seattle to Electron where is located the equally interesting and much larger plant of the Puget Sound Power Company.† There is a further possibility that a three days' trip over the Puget Sound region, including a visit to the Victoria and Vancouver transmission systems of the British Columbia Electric Railway Company, Ltd., may be arranged, and that upon the return to Seattle the Ballard Electric Company, of Ballard, Wash., in conjunction with some of the electrical interests in Seattle, may give an excursion to Alki Point in order to wind up the pilgrimage with a *genuine* clam bake.

As stated previously both the Transmission Association and the Engineering Congress have selected as head quarters the well known "American Inn"—well known to all exposition visitors as the same institution which earned world-wide popularity at the Pan-American and Louisiana Purchase Expositions. It will be the aim of the Lewis and Clark Exposition to conduct the "American Inn" as a strictly first class hotel, indeed it will have all the modern conveniences of an up-to-date summer resort, and its superb location on the western shore of Guild's Lake within the Exposition grounds enables its guests to have a vista of the Exposition together with the background of river, forest and snow-capped mountain scenery that, together, has never before been equaled. The Inn contains two parlors, each of which will easily seat five hundred people and these parlors will form the meeting places for the Congress and the Transmission Convention respectively. The visiting delegates will receive special rates, which may be on either the American or European plan. On the European plan the rates will range from $2.00 to $3.00 per

*THE JOURNAL Volume XI, page 5, January, 1901.
†*Ibid*, Volume XIV, page 403, October, 1904.

day including breakfast and a single room without bath, and in rooms with bath the rates for single persons will be from $4.00 to $5.00 per day. On the American plan the rates range from $3.50 to $4.50 per day without bath, and from $6.00 to $7.00 with bath. When two or more persons occupy the same room these rates are subject to reduction and all rates include daily admission to the Exposition grounds after having become a registered guest of the Inn.

As to transportation, the Southern Pacific Company is issuing a special ten days' excursion ticket to Portland and return over its famous Shasta route for the sum of $25.00, with the privilege of an extension of eleven days on payment of $5.00 additional and of ten days more on payment of $5.00 further, making the cost of a twenty-one day ticket to be $30.00 and of a thirty-one day ticket to be $35.00. These tickets must be used for the return to San Francisco on or before the date of expiration. If, however, the Transmission Association will guarantee to organize a party of not less than one hundred and twenty-five passengers, the Southern Pacific Company will run a special train for the Association to Portland, leaving the starting point on any day that it may be desired, and tickets therefor to be good to return from Portland to San Francisco upon any regular first-class train within the limit of expiration. Such tickets, good for the round trip and limited to ten days after the date of sale, will cost $20.00, with the proviso that one hundred and twenty-five be sold as stated, and extensions on these special tickets may be obtained on the same basis as previously indicated, that is, a twenty-one day ticket will cost $25.00 and a thirty-one day ticket will cost $30.00. These special rates, based on $20.00 per capita, will be sold from all points north of and including San Jose, Tracy, Lathrop and Stockton; when sold from points south of the cities named the ten days round trip rate for the special excursion of the Association will be on the basis of $25.00 per capita.

In the event 125 such tickets are not sold the full first-class fare of $20.00 each way must be paid.

It should be emphasized that to secure the very favorable rate of $20.00 for the round trip it is incumbent on the Association to guarantee that at least one hundred and twenty-five passengers will accompany the excursion, but the advantages to result from the organization of such a party are not those of reduced railway rates alone for the reason that it will be impossible to travel in greater comfort or congeniality than in the special train, first class in every possible respect, which will be furnished by the Southern Pacific Company. It should be added, moreover, that the passengers for this special train are not restricted to members of the Transmission Convention or to delegates to the Congress alone, but instead guests and friends of the attendants to both meetings may accompany it under these favorable priviliges.

THE DENVER CONVENTION N. E. L. A.

THAT which gives every promise of being one of the most successful conventions ever held by the National Electric Light Association will be held in Denver and Colorado Springs the week of June 5th. The committees have arranged for a broncho-busting contest, a tour of the mining districts that have made Colorado famous in the last fifteen years, entertainment at some of the best clubs in Denver, a smoker, splendid music and a dozen trips optional with the delegates.

It is figured that all of the delegates and their friends will reach Denver on June 5th, Monday morning. On the evening of this date an informal reception will be held at the Brown Hotel which will be the headquarters of the convention during the week. On the following day the business sessions of the convention will begin and will extend over a period of three days. It is probable that the delegates will be obliged to hold several night sessions in order to hurry through with the deliberations of the convention.

The broncho-busting contest promises to afford a day's pleasure which will be greatly enjoyed by the visiting party. The worst "outlaws," horses that have tested the best horsemanship among the cowboys of mountain and plain, will be gathered together from the big ranches of Colorado and Wyoming, so that nothing will prevent the exhibition of the most spectacular feats of which the Western cowboy is capable in the management of these untrained steeds that run wild in the mountains and on the prairie. One of these horses captured a short time ago has thus far defied the skill of every cowboy in the West. No rider has been able to remain on his back more than a few minutes. This horse will be a special feature of the contest.

The ladies attending the convention will be entertained by the women of the Denver Country Club on one of the afternoons of the stay in Denver. If any of the fair visitors desire to play a game of golf they will have the pleasure of doing so, as the club boasts one of the finest golf courses in the West.

The men will be regaled with the amusement which will be furnished by a smoker to be given in Coliseum Hall, a building which has a seating capacity of several thousand. The committee in charge of the event announces that they have prepared a program which they say will meet with the warmest appreciation by the visiting delegates.

The visitors will be taken to Colorado Springs on Friday morning on a special train. The trip over the Divide will be enjoyable as some of the best scenery of the various mountain ranges may be seen as the train flies in the direction of the city at the foot of Pike's Peak. Carriages and automobiles will be on hand when the delegates arrive at the Springs and a journey will begin immediately to all points of interest in the vicinity of Colorado Springs and Manitou. As there are many interesting places to be visited, the day's sightseeing will last until past six o'clock.

A trip will be made to Cripple Creek, the world's famous gold camp, on the following day. The scenery which can be viewed from the Short Line train as it progresses up the steep grade to Cripple Creek equals in grandeur the best mountain scenery in the world. A visit will be made to the great gold producing mines in Victor and Cripple Creek where millions have been taken from the depths of the mountains. Upon the return of the delegates to Colorado Springs they will be taken to the Broadmoor Casino where they will have an opportunity of recovering from the day's sightseeing. All sorts of amusement are provided at this noted resort and the evening will prove highly enjoyable.

On Sunday the delegates may take any trip they choose. Some will probably want to go to the top of Pike's Peak. If any of the delegates and their friends desire to see the Sun rise above Pike's Peak in the morning, a sight which is awesome in its splendor, they should start to make the climb on Saturday night. This would get them to the top of the Peak just as the dawn is breaking through the white mist. The easiest way to get to the top of the Peak is by the cog road.

Nearly all of the delegates will probably return to Denver on Monday. If they care to see further points of interest in Colorado

they will have a chance to do so as several of the railroads running out of Denver will have excursions on Monday and Tuesday. The rates will be low.

The following programme of business and social features of the convention will be adhered to:

MONDAY, JUNE 5TH.

Arrival of delegates; reception by local committees; informal reception, with music, at headquarters, the Brown Palace Hotel.

TUESDAY, JUNE 6TH.

Morning—Business session in ordinary of Brown Hotel; addresses of welcome by Governor Jesse F. McDonald, Mayor Speer, of Denver, and Mayor Hall, of Colorado Springs.

Afternoon—Business session; Country Club luncheon for ladies.

Evening—Theater party at Elitch's Gardens.

WEDNESDAY JUNE 7TH.

Morning—Business session.

Afternoon—Broncho-busting contest at D. A. C. Park.

Evening—Business session until 10 p. m.; at 10:30 p. m. an "athletic" smoker at either the Democratic Club or Coliseum Hall; party at Orpheum for the ladies (if theater is open).

THURSDAY, JUNE 8TH.

Morning—Business.

Afternoon—Business; street car rides for the ladies.

Evening—Business; serenade by the George W. Cook drum corps.

FRIDAY, JUNE 9TH.

Morning—Entire party transported to Colorado Springs.

Afternoon—At Colorado Springs—drives to all of the famous scenic points; visits to the power plants; trips up Pike's Peak.

Evening—Dance and concert at the Broadmoor Casino.

SATURDAY, JUNE 10TH.

All day—Special trains to the Cripple Creek district and return.

SUNDAY, JUNE 11TH.

All day—Trips to the scenic points about Colorado Springs, each delegate taking those he was unable to take on Friday.

Monday and Tuesday will be devoted to excursion parties arranging for those desiring to go over the Moffat Road and the Loop.

THE EFFECT OF FLOODS ON WATER POWERS.*

BY PROF. S. M. WOODWARD.

THE first result of an increase in flow of a stream is to increase the power available for use by the water power plants situated on its banks. But as the stream rises, especially if its ordinary flow be somewhat sluggish, it is usually the case that the water rises at a less rapid rate in the pond above a dam than it does in the more shallow portion just below the dam. Hence the rise in the head race does not keep pace with the rise in the tail race and the total head available decreases. This tends to decrease the available power and to offset the first effect of the increased discharge.

In extreme floods a low dam may be so far submerged as to produce scarcely any fall in the surface of the river, in which case the available power has been reduced to zero. If with the first rise in the river the power is increased, but with a sufficiently great rise it is decreased to zero, it follows that there must be some stage of the river at which the power is a maximum.

This may be illustrated by data taken from observations on the Iowa River at Iowa City. Since June, 1903, the United States Geological Survey has maintained a gaging station at this city. Numerous measurements of the discharge of the river has been made, and these measurements have been plotted on the accompanying diagram, using the reading of the river gage in feet for ordinates and the discharge in cubic feet per second for abscissæ. The date of each measurement is indicated near the point denoting the amount.

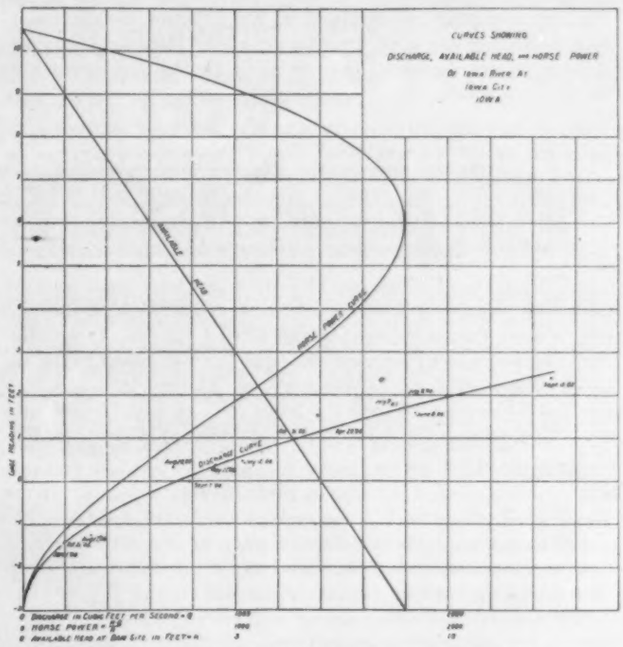
For the purpose of calculating the power of the stream, we assume a dam with a crest eight feet above the minimum stage of the river, which is at—1.5 feet on the gage. This puts the crest of the dam at the point 6.5 feet on the gage. The relative rates at which the water will rise during a flood on the crest of the dam and in the tail race can only be estimated, but from the best information that can be obtained from a similar plant two miles above, it seems fair to assume that the water will rise three times as fast in the tail race as on the crest of the dam. On this assumption the head may be computed for all stages of the river. The relation between the rates of rise of head water and tail water would be different at every different location, and the ratio would probably not be constant at the same location, so the above assumption should be regarded as only approximate. It is a matter in which some careful series of observations would be of great value.

If H = head in feet,

Q = discharge in cubic feet per second, and the efficiency of the water wheels is 80 per cent.

$$\text{Horsepower} = \frac{62.5\,H\,Q}{550}\,\frac{80}{100} = \frac{H\,Q}{11}$$

By the above formula the horsepower may be calculated for different stages of the river when the corresponding discharges are known. Floods of much magnitude are usually of short duration, and it so happens that the discharge of the Iowa River



THE EFFECT OF FLOODS ON THE WATER POWER OF STREAMS.

has not yet been measured for any very high stage. It is apparent that the highest measurement does not reach the point of maximum horsepower, and hence to complete our illustration, it is necessary to resort to calculations. Assuming the discharge curve to be a parabola, its equation may be found and is as follows:

$$Q = 81.3\,(G+3)^2$$

in which G is the gage height of the river. This parabola is drawn on the figure in order that it may be seen how nearly it agrees with the measured discharge of the river at different gage heights.

The available head is given by the equation:

$$H = \frac{21-2G}{3}$$

Hence,

$$\text{Horsepower} = \frac{HQ}{11} = 2.464\,(G+3)^2(21-2G)$$

*From the Proceedings of the Seventeenth Annual Meeting of the Iowa Engineering Society, University of Iowa, Iowa City, Iowa.

To find the point of maximum horsepower, equating the first derivative to zero we obtain $G = 6$, and substituting this in the equation for horsepower, we find the maximum horsepower to be 1796. The available head and the horsepower according to the above equation are plotted on the diagram above, showing graphically the point of maximum horsepower and the rate at which the horsepower varies.

PERSONAL.

Mr. John I. Beggs, who has for years been among the foremost managers of central station properties through the Lake regions, has been elected to the presidency of the National Electric Company, of Milwaukee, Wis.

Mr. Emile Guarini, the well known European contributor to THE JOURNAL, has left Brussels, Belgium, his former home, for Lima, Peru, where he will henceforth be located as professor of the Lima School of Engineering.

Mr. W. R. Dunbar has resigned from the sales department of the California Electrical Works and is now located in the San Francisco office of the H. W. Johns-Manville Co., of New York, in charge of its electrical department.

Mr. S. I. Wailes has been promoted from the position of Pacific Coast representative of the air brake department of the National Electric Company, of Milwaukee, Wis., to the assistant sales managership of the same department of the National Company, and his former position has been filled in the appointment of Mr. A. H. Metzelaar.

Mr. F. H. Jones, formerly manager of the air compressor department of the International Steam Pump Company, has assumed the duties of general sales manager of the same company and is taking up the organization of a comprehensive and thoroughly co-ordinated general sales department, similar to those recently organized by several of the large corporations.

Mr. W. S. Heger, whose well known managerial qualities have made him prominent in electrical circles of the West for the past fifteen years, first as manager of the United Edison Manufacturing Company's San Francisco office and later as manager of the San Francisco office of the Westinghouse Electric Manufacturing Company, has resigned from the latter position and is now with the Allis-Chalmers Company in its main office at Milwaukee, Wis.

Mr. R. B. Elder, whose biography appeared in these columns some years ago* and who, since then became manager of the Wagner-Bullock Electric Company, of California, has been promoted to the San Francisco district office of the Allis-Chalmers Company, accompanying the interests of the Bullock Electric Manufacturing Company formerly handled by the Wagner-Bullock Company, and which, as is well known, have been taken over by the Allis-Chalmers company.

Mr. C. E. L. Brown, of Brown, Boveri & Cie, for which the Crocker-Wheeler Company is American licensee, has been chosen as electrical expert for the Administrative County of London and District Electrical Power Company which is responsible to a committee of the British House of Lords, and which is planning to construct three electrical plants for generating current to supply the whole of London and those suburbs controlled by the London County Council. Each plant is to consist of six turbo-generators, each of 10,000 kilowatts normal and 20,000 maximum capacity, making a maximum total of 360,000 kilowatts. As these power units are larger than any ever constructed, experts have been appointed to decide upon the practicability of units of this size.

Mr. Leon W. Bly, late representative of the Fort Wayne Electric Works and the Electric Appliance Company, at Chicago and Lincoln Neb., and who became well known in electrical circles in California through the delivery of a paper "Random Notes on Extremely High Potentials"* read before the second annual Convention of the Transmission Association as well as through his contribution to these columns† on the Provo-Mercur 40,000-volt transmission, has become identified with the San Francisco office of the Westinghouse Electric and Manufacturing Company in the machinery sales department. Mr. Bly has a thorough engineering experience, as well as broad experience in commercial lines, which qualifies him for the new duties into which he has entered.

Mr. W. W. Briggs, who has been in the employ of the Westinghouse Electric and Manufacturing Company as salesman since January 1899, has been promoted to the position of manager of its San Francisco office, vice W. S. Heger, resigned, who has become identified with the main office of the Allis-Chalmers Company, at Milwaukee, Wis., as elsewhere noted. The rise of Mr. Briggs to his present position of responsibility is typical of that which individual work and unremitting effort can accomplish. His experience in the electrical field dates back to the days of the California Electric Light Company, when in 1877 he entered its repair shop. Next he entered the employ of the San Francisco office of the Westinghouse Electric and Manufacturing Company which was then represented on the Pacific Coast by the late W. C. Clark.‡ This office was closed in 1892, whereupon Mr. Briggs became identified with the Electrical Improvement Company, during which time he installed much pioneering work, notable in the mining regions of the Salmon River district, in Idaho, and at the North Bloomfield Mine, Nevada County, Cal. More extended references have been made to his work in these columns heretofore.§ At the conclusion of this work, in May, 1897, he became sales agent for the Pacific Coast office of the Fort Wayne Electrical Corporation where he remained until he became identified with the company for which he is now manager. His promotion has called forth universal congratulation, for it is thoroughly merited.

Mr. A. J. Myers, who has just been appointed Pacific Coast district manager of the Wagner Electric Manufacturing Company, with headquarters on the fourth floor of the Rialto Building, dates his electrical experience from 1882, when he entered the service of the Hartford Electric Light Company, at Hartford, Conn., where he remained for four years, when he entered the shops of the Waterhouse Electric Manufacturing Company, which was then engaged in the manufacture of Waterhouse arc lamps and dynamos. Two years later, in the spring of 1888, the Waterhouse Electric Company of Baltimore was organized. In it Waterhouse arc lighting apparatus was used throughout and Mr. Myers was placed in charge of the erection and operation of the plant under the title of superintendent.

In February, 1890, the General Electric Company of Sacramento had so far progressed in the erection of its arc lighting system that Mr. Myers was called to that city to superintend its installation, which consisted of two 750-light Westinghouse alternators and four fifty-light, 2000-candle-power, Waterhouse dynamos, with the accompanying Waterhouse arc lamps. This company had been organized through the efforts of the late Mr. W. C. Clark, together with Messrs. Charles Crocker, J. D. Redding and others. The company, however, was but short lived, for in about a year it was sold to the Capital Gas Company, thus forming the nucleus of the electrical business of the present Sacramento Electric, Gas and Railway Company. Throughout its brief existence Mr. Myers carried the engineering responsibilities to a thoroughly successful issue.

Upon the transfer of the property of the Central Electric Company to the Capital Gas Company, and inasmuch as Mr. Myers' contract with the former had expired simultaneously therewith, he came to San Francisco in acceptance of a position of district engineer of the San Francisco office of the Westinghouse Electric and Manufacturing Company, of which Mr. Clark was man-

*THE JOURNAL Volume VI, page 107, November, 1898.

*See THE JOURNAL Volume VI, page 5, July, 1897.
†*Ibid*, Volume V, page 169, June, 1898,
‡*Ibid*, Volume XV, page 149, April, 1895.
§*Ibid*, Volume XI page 26, January, 1901.

ager. Three months later, however, the finances of the company were in such shape, as is well known, as to necessitate the closing of the San Francisco office, whereupon Mr. Myers entered the service of the Electric Improvement Company of San Francisco, where he remained until the fall of 1892, when the Westinghouse Electric and Manufacturing Company again reopened its San Francisco office as an agency under the management of J. M. Thompson. Thereupon Mr. Myers resumed his connection with the Westinghouse Company again in the capacity of district engineer for the San Francisco office. The agency arrangement, however, existed for but a year; nevertheless during this period considerable business was transacted, particularly in the installation of three 1000-light Westinghouse alternators and one fifty-light, 2000-candle-power, Western Electric arc lighting system at Eureka, a railway equipment at Stockton and in several lighting installations on bay and ocean steamers, all of which were erected under the immediate direction of Mr. Myers.

The discontinuance of the Westinghouse agency arrangement resulted in the return of Mr. Myers to the Electric Improvement Company, which, through the recommendation of George Arnold, its secretary, organized an electrical repair shop to be operated under the direction of the subject of this sketch. Here he remained until October, 1894, when he entered the employ of the California Electrical Works in the capacity of salesman. At that time the concern last named was expanding its business into power lines, and among the agencies of importance which it secured, to a material extent through the enterprise of Mr. Myers, were those of the Wagner Electric Manufacturing Company, the Helios Arc Lamp Company and the Western Electric Company. Soon after, early in the spring of 1896, the California Electrical Works secured a contract for the installation of the municipal electrical transmission and distribution system of the City of Riverside, Cal. This system, which has been described in detail in these columns heretofore*, consisted of three 100-kilowatt transformers placed in the original station of the Redlands Electric Light and Power Company for raising the three-phase current there generated from 2500 volts to 11,000 volts, for three-phase transmission over 22.5 miles of line, for transmission to Riverside, whence it was delivered to three eighty-five kilowatt Wagner transformers, delivering 2000 volts in three-phase current. The plant is still in operation by the City of Riverside as originally installed, with the exception that the rearrangement of the power plant has necessitated the taking of current from larger transformers in the power house. The entire installation was erected by the California Electrical Works, under the engineering supervision of Mr. Myers.

Mr. Myers remained with the California Electrical Works in the capacity of engineer and salesman until April 20, 1904, when he entered the employ of the Wagner-Bullock Electric Company of California, with which he has been identified as engineering salesman until the present time. During this period his attentions have been devoted to the sale of the products of both the Wagner Electric Manufacturing Company and the Bullock Electric Manufacturing Company.

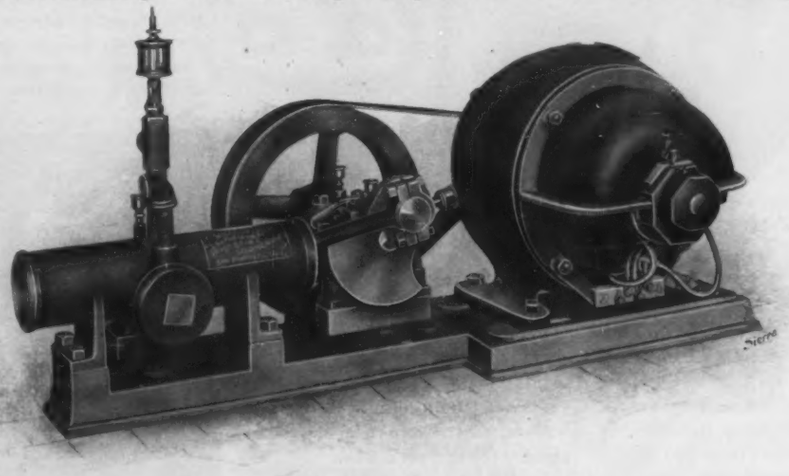
Mr. Myers has always been an enthusiastic advocate of single-phase motors, and it is a noteworthy fact that he made the first sale of the well-known Wagner single-phase motors on this coast, which were installed in Santa Rosa some seven years ago, and which are still in successful operation.

* THE JOURNAL, Volume IV, page 21, May, 1897.

INDUSTRIAL

THE RIX "BABY" AIR COMPRESSORS.

FOR a number of years there has been a constantly increasing demand for air compressors which are much smaller than those manufactured, and this demand calls for a compressor that, while small, shall be a practical machine of good efficiency, which shall be built with as faithful regard for perfect workmanship as is found in larger compressors, that is, which shall have water jackets, piston ring packing, and proper jounals and crank pins as well as reliable valve mechanisms for realizing pressures of 100 pounds to the square inch or more.



THE RIX "BABY" AIR COMPRESSOR

Difficulties heretofore existing have been solved by the Rix Compressed Air and Drill Company, of San Francisco, in designing and building a small compressor that may be driven at the high speed of from 300 to 500 revolutions per minute with perfect capacity and high economy. In it all poppit valves and springs are eliminated, and instead there is used but one simple rotor, which enables the machine to be run noiselessly.

Rix "Baby" compressors are made in four styles, only one of which—Style "D"—is equipped with poppit valves. This is eminently a small compressor for central station and manufacturing plant equipment. It is designed to be belt driven from a two horsepower electric motor, and the compressor proper is a duplex single acting machine with water jackets, lubricators, oilers, steel valves and shafts and connecting rods of bronze. Neither noise nor vibration accompanies its operation, hence the machine need not be belted to the floor, but can be used on a portable truck and moved from place to place as may be necessary in blowing the dust from generators, air blast transformers, back of switchboards and elsewhere in electric power houses, as well as in practically every other class of manufacturing plant. The combination motor and compressor weighs 898 pounds, and it compresses ten cubic feet of air per minute to pressures ranging from 10 to 150 pounds.

Style "A" compressors, one of which is illustrated herewith, are built in four sizes ranging in compression duty from ten to sixty-five cubic feet of free air per minute at pressures ranging to 100 pounds and consuming from two to fourteen horsepower.

Small Rix compressors are now in general use throughout the West.

The California Electrical Works.

IF its history be regarded as dating from the very earliest inception of the electrical supply business on the Pacific Coast, that is, from 1868, the California Electrical Works is undoubtedly entitled to the distinction of being the oldest electrical supply house in the Far West, and to this coveted laurel it has now added the further one of being the largest in points of magnitude of stock carried and business transactions. Historically its title dates from 1877, when it was incorporated as the California Electrical Works, in which was consolidated the businesses of the Electrical Construction and Maintenance Company, organized in 1868 and incorporated in 1871, the California Electric Power Company, the Pacific Electro-Depositing Works and the California Electric Gas Lighting Company. The place which this institution made for California in the early electrical history of electrical industries of the country has been discussed fully in these columns heretofore*, and identified with it were the names of the late Monroe Greenwood†, who was president from the time of its incorporation to October 11, 1896, the date of his death; Stephen D. Field, George S. Ladd, John I. Sabin, Paul Seiler and others.

W. E. ELLIOT, TREASURER

L. E. SPERRY, MANAGER

A. W. GOULD, TELEPHONE SALES

E. L. WAYMAN, SUPPLY SALES

In 1902, however, the California Electrical Works became identified with the interests of the Western Electric Company of Chicago, acting as Pacific Coast agents for the latter concern in the territory embraced by the states of California, Oregon, Washington, Nevada and one-half of Arizona, together with the American possessions in the Pacific Ocean.

Since that time the business has grown to such proportions that the company has outgrown its present quarters, and is erecting a new building for accomodating its rapidly increasing business. The illustration on page 245 presents a view of this new building as it will appear when completed, and the structure, which is now being erected, is located on the north side of Folsom Street, near Hawthorne Street, a small thoroughfare running parallel with and between Second and Third Streets. This location can best be defined by stating that the new structure is being erected in the block almost immediately behind the old steam plant of the Mutual Electric Light Company, that occupies so prominent a position at the head of New Montgomery Street. The advantages of this site are evident, for, while it is convenient to the electrical center of the city, it is sufficiently removed therefrom to be eligible to the advantages of the manufacturing district. The new structure will contain approximately 72,000 square feet of floor space, or an increase of practically 25 per cent. over that of the old one.

Speaking generally, the building will consist of two sections, each containing four floors. The first section, which is 112x96 feet in size, will be devoted entirely to warehousing purposes, and the second section, occupying a ground space of 156x47 feet, will be used in three floors for manufacturing or shop purposes, while its top floor will be subdivided into the offices of the company. A portion of the lower floor will contain boiler and engine rooms for the development of power, whence will be distributed the electrical service for the premises.

H. B. SQUIRES, APPARATUS SALES

In laying out the building especial care was taken to design it with due regard for safety from fire, with the result that the entire premises are of mill construction, with walls of brick, faced with a dark red repressed brick, and with windows of wire-glass throughout, all features being in strict accord with the requirements of the fire underwriters. Under the rear courtyard there will be excavated a reservoir having a

* THE JOURNAL, Volume XV, page 81, March, 1905.

† *Ibid*, Volume III, page 69, October, 1896.

capacity of 120,000 gallons of water, while on the roof there will be built a 50,000 gallon tank, which will supply water for the automatic sprinklers with which the premises will be equipped. The arrangement of every feature is such as to secure the highest attainable efficiency in the transaction of business from every viewpoint.

J. E. CRILLY, BUYER

The power plant will consist of two 100-horsepower tubular boilers, supplying steam to two high-speed engines, each of which will be direct connected to a seventy-five kilowatt, 220-volt, direct-current generator, whence will be supplied the current for all purposes. Both lighting and power service will be rendered at 220 volts, and it is perhaps needless to state that the electrical equipment throughout the premises will be of the latest type of Western Electric apparatus.

In going through the premises of the California Electrical Works one is greatly impressed by the amount of detail encountered in giving the prompt and satisfactory service this company is aiming to afford its customers. This impression leads to an examination of the clerical work involved which might well be described by the course taken by an order through the various departments.

The career of an order, from the time when in its early life it evades capture until at last it is seized upon and domiciled by the successful salesman, on to the time when its life work is closed by the settlement of the account which it incurred, is truly a devious and lively one when its lot is cast with a concern of the magnitude of the California Electrical Works. The first task is that which befalls the salesman, namely, to get the order. This is done generally through submitting a quotation sheet on the line of goods which the prospective customer desires. Quotations are, of course, made by salesmen, and in this particular concern the quotation sheet is in duplicate, and in filling it out two other blanks are inserted, so that, in addition to the original quotation, three typewritten copies of it are made. The first of these is a copy for the use of the billing department in case the order is secured; the second copy goes to the sales department for its information and record, while the third copy, which is attached to the original copy through a perforated scoring, is for the use of the prospective customer should the quotation be accepted. The blank forms used are such that the original copy becomes a letter of quotation to the customer, while the third copy, which it will be remembered also goes to the customer, is used by him as an order in case the quotation is accepted. It contains, further, instructions for shipment, a space for remarks and a notation to the prospective customer reading: "If you favor us with your order, please send it in this form. If you prefer the usual order blank, kindly attach this to it, as it completes our records and reduces the liability of mistakes."

H. H. SEPHTON, SUPT. OF CONSTRUCTION

A CORNER IN THE MANAGER'S OFFICE

If the quotation is accepted and the order given, the latter, if sent by letter post, as the great majority of all orders are, goes at once to the mail clerk, who opens the correspondence, assorts it as necessary and keeps all orders among themselves. These are numbered consecutively and recorded, when they are passed on to the credit department where the financial responsibility of the individual or concern which files the order is examined into and approved or disapproved, as the case may warrant. If approved the order is taken to the order department, where it is first "edited," wherein each item of the order is given its correct catalogue number and trade designation. The "editor," in addition, passes upon the correctness of the prices quoted, and as well upon the prices paid for articles bought from outside houses through the purchasing department. This so-called editing further consists in transferring the order from its original form to special blanks, known respectively as the "shipping ticket and charge slip," which

H. C. HASSELBACK, STOREKEEPER

RICHARD SPENCER,
LOS ANGELES REPRESENTATIVE

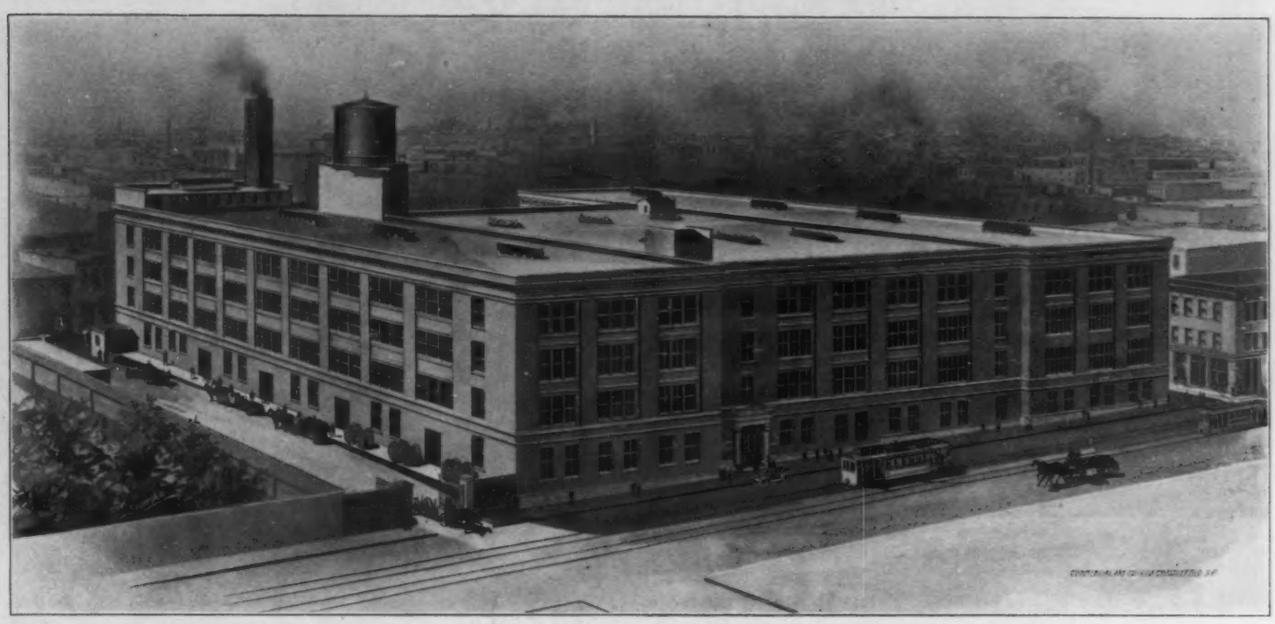
IN THE SALES MANAGER'S OFFICE

finally reaches the accounting department; the "stock record sheet," from which the stock cards are made up, and the "shipping notice," which accompanies the shipment to the customer. Simultaneously with these three copies, two additional ones are made, one of which is on plain blank paper and is filed for record in the editing department, and the other, which is on pink paper, goes to the accounting department and is filed in its binder, where its distinctive color serves as a reminder that the goods mentioned therein have been neither charged nor billed. The "shipping ticket and charge slip" accompanies the order while it is being assembled clear through to the final shipping, when it is returned to the accounting department and placed in the permanent binder in lieu of the pink slip, which is taken out and destroyed.

These various slips, commonly called "tickets," contain all information necessary to enable the order to be traced step by step through its various stages. In this checking employees' initials are used, and the "shipping ticket and charge slip," for instance, give the following information: The party to whom the goods are billed and to whom shipped, the route of shipment, the number, weight and style of shipment, the date of the bill and the initials of the party by whom the bill was checked, by whom the order was edited, inspected and assembled, the salesman's initials, the number of the customer's order and its date, the register number of the order, the date when it was issued and date when delivered to the shipping department, as well as the date of shipment. If delivered direct on a receipt, the receipt number appears. Notation is also made of the initials of both the packer and the marker, of the quantity of material required to fill the order, of the quantity shipped, of the quantity "back-ordered"—that is, of any shortage in shipment to be filled later, as well as the price on each item, the discount thereon and the amount due therefor. This information, which, as stated, appears on the "shipping ticket and charge slip," is typical of that which the other tickets contain, except that the packing slip contains no prices.

As may well be imagined, it is no small task to keep a record of each individual line of goods in stock in an establishment carrying values to the amount of many hundreds of thousands of dollars and where the quantity is constantly fluctuating. These records are maintained from the "stock record sheet" above referred to, by means of the stock cards. Each separate article which bears a number and catalogue is given a card number corresponding to that of the catalogue, and this card describes the item by name and catalogue number, the minimum quantity to be carried in stock, the unit package conforming with the size adopted by its manufacturer and the size of the standard package in which it is packed. For instance, a standard package may contain a dozen or a gross, as the case may be, of that particular article. This information, being of a fixed character, appears prominently at the top of the card, and below it, in semi-ledger form, are ruled columns showing in the consecutive columns the amount ordered, the requisition number and the date received—these obviously according informa-

THE MISSION STREET PREMISES OF THE CALIFORNIA ELECTRICAL WORKS



WAREHOUSE, FACTORY AND OFFICES OF THE CALIFORNIA ELECTRICAL WORKS, SAN FRANCISCO, NOW IN COURSE OF CONSTRUCTION

tion on the replenishment of goods. To the right of the double line appears first a date column, then the number of the customer to whom goods are sold, the amount of goods sold or distributed to him, and, finally, the running balance of the stock on hand, for, as stated, when this running balance reaches the "low water mark" set forth as minimum, a requisition must be placed for its replenishment.

The assembling of the goods for shipment is done in the warehouse direct from the "shipping ticket and charge slip," the goods being collected in table bins by order clerks, after which they pass under examination by an inspector, who checks not only the items of the shipment, but also the condition of each. The shipment is then transferred to the packing department, where it is again inspected by the packers, but if it contains a back order that can be filled in a short time—that is, within a few hours, it is allowed to remain on the assembling table until the purchasing department will be able to supply the deficiency. "Back orders" are indeed the most serious detriment to promptness in shipping, but their existence is an evil that appears to be inherent to the trade, for it is impossible for any single establishment to

HERE COUNTER SALES ARE MADE

ONE OF THE STENOGRAPHERS' ROOMS

THIRD FLOOR OF THE WAREHOUSE

SECOND FLOOR OF THE WAREHOUSE

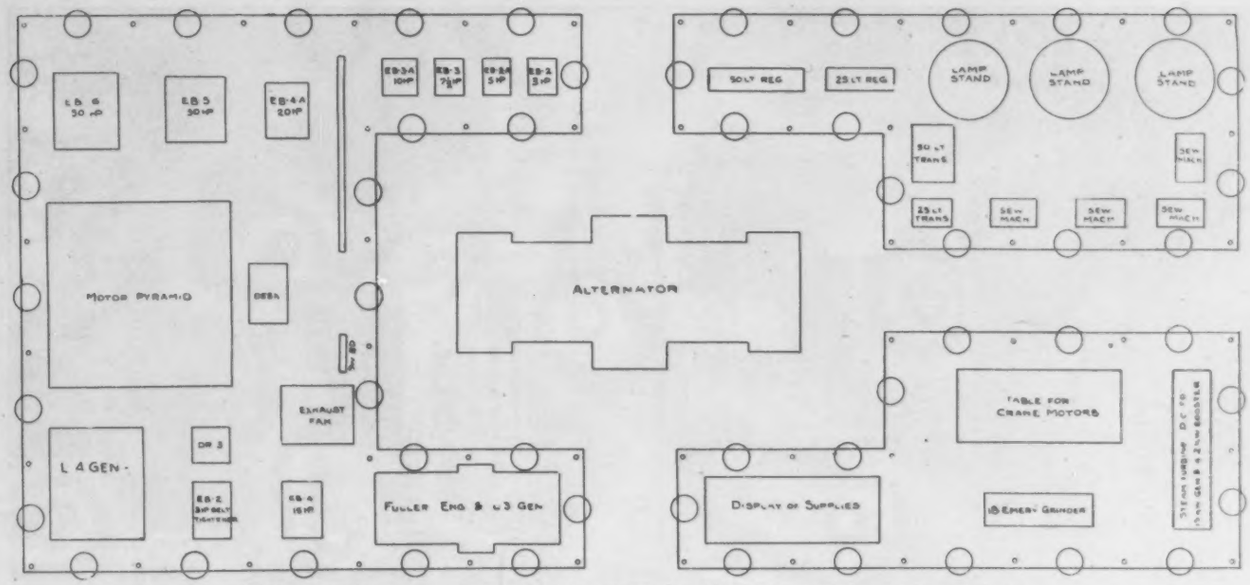
A CORNER OF THE SHIPPING DEPARTMENT

carry a stock that will cover every article known to the trade in sufficient quantity to meet every demand that may arise. Furthermore, the custom in vogue by which manufacturers place their interests in the hands of exclusive agents makes it imperative that goods should be bought of these agents as ordered; but, nevertheless, despite these handicaps most excellent results are achieved in the prompt shipment of orders. It is a rule in an establishment of this nature that the facilities for handling orders quickly shall be such as to enable it to make shipments within thirty-six hours after the receipt of the order, in which event the efficiency of shipping service is fixed at 100 per cent. The record of the California Electrical Works in this direction shows that during the present year this efficiency has never fallen below 82 per cent., while the maximum is 88 per cent., with an average of 86 per cent. These are the efficiencies of shipment for all classes of orders, including "back orders," and were percentages given of shipments direct from stock, it would be found that they would reach the superb efficiency of at least 96 per cent.

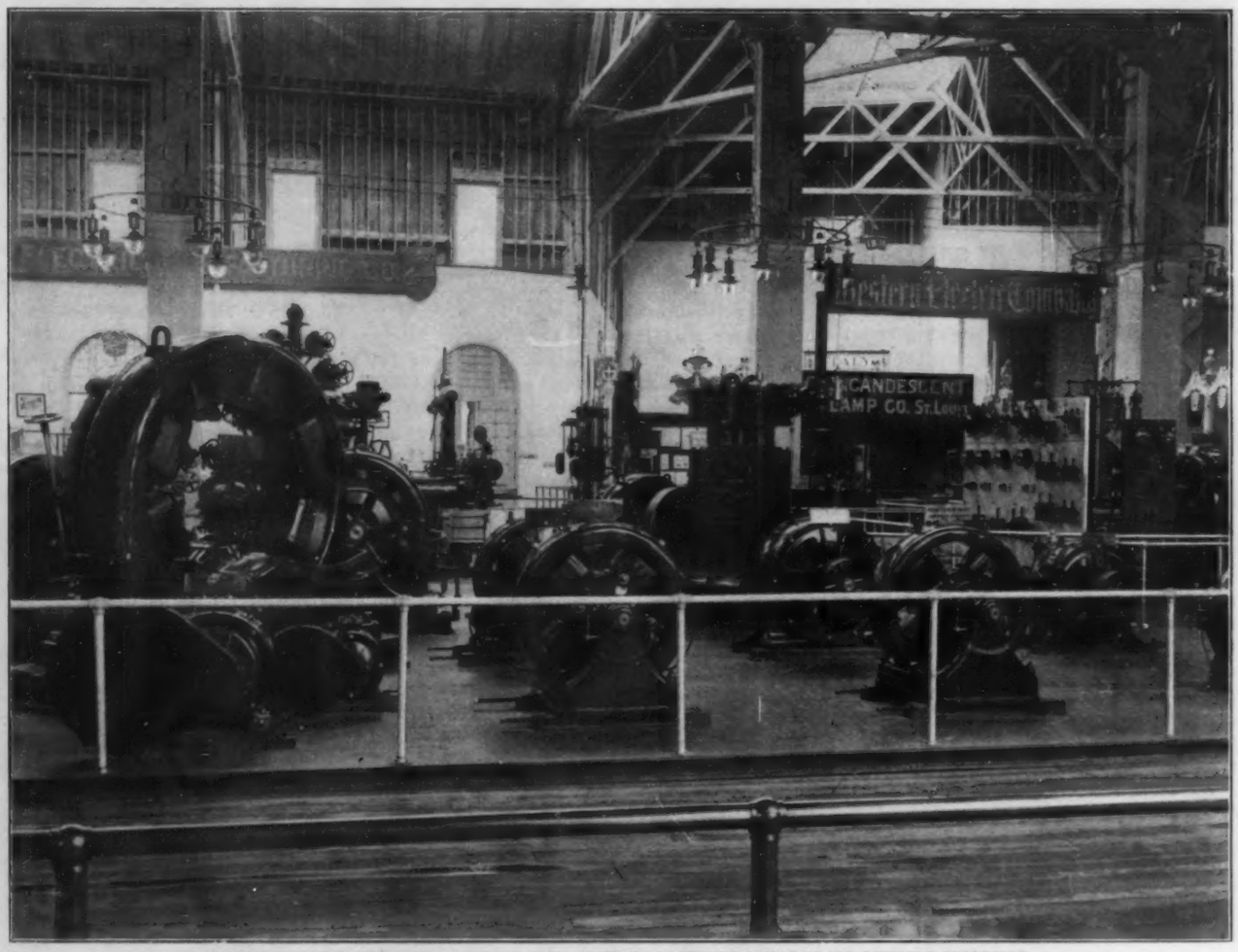
One of the most imposing individual electrical exhibits to be seen in the Machinery, Electricity and Transportation Building of the Lewis and Clark Centennial Exposition is that of the Western Electric Company. It occupies a space approximating 2000 square feet, and its central feature is of especial significance in that it consists of a 500-kilowatt, three-phase, revolving field, engine-type generator. The significance of this exhibit cannot be overestimated, for it marks the entry of the Western Electric Company, with its great capital, into the field for the manufacture of polyphase machinery. In due season full details of the exhibit will appear in these columns. The central section, containing the Western Electric generator referred to, is surrounded by exhibits typifying all the products of the company, with particular reference to power apparatus. The most prominent feature is a pyramid of motors. Individual motors, ranging in capacities from those required for sewing machines up to fifty-horsepower, are shown, as well as a complete operative exhibit of the Western Electric alternating current series inclosed arc lighting systems, with transformers and regulators. Another section carries a display of supplies handled by the company, such as Bryant & Perkins' goods, Thomas' high potential porcelain insulators, Electrose overhead railway material, D. & W. inclosed fuses, "Sunbeam" lamps, direct and alternating current fan motors, an assortment of sewing machine motors and emery grinders, as well as a Ratteau steam turbine that is direct connected to a fifteen-kilowatt Western Electric, 220-volt, direct current generator.

HEAVY STOCK IS CARRIED IN THE BASEMENT

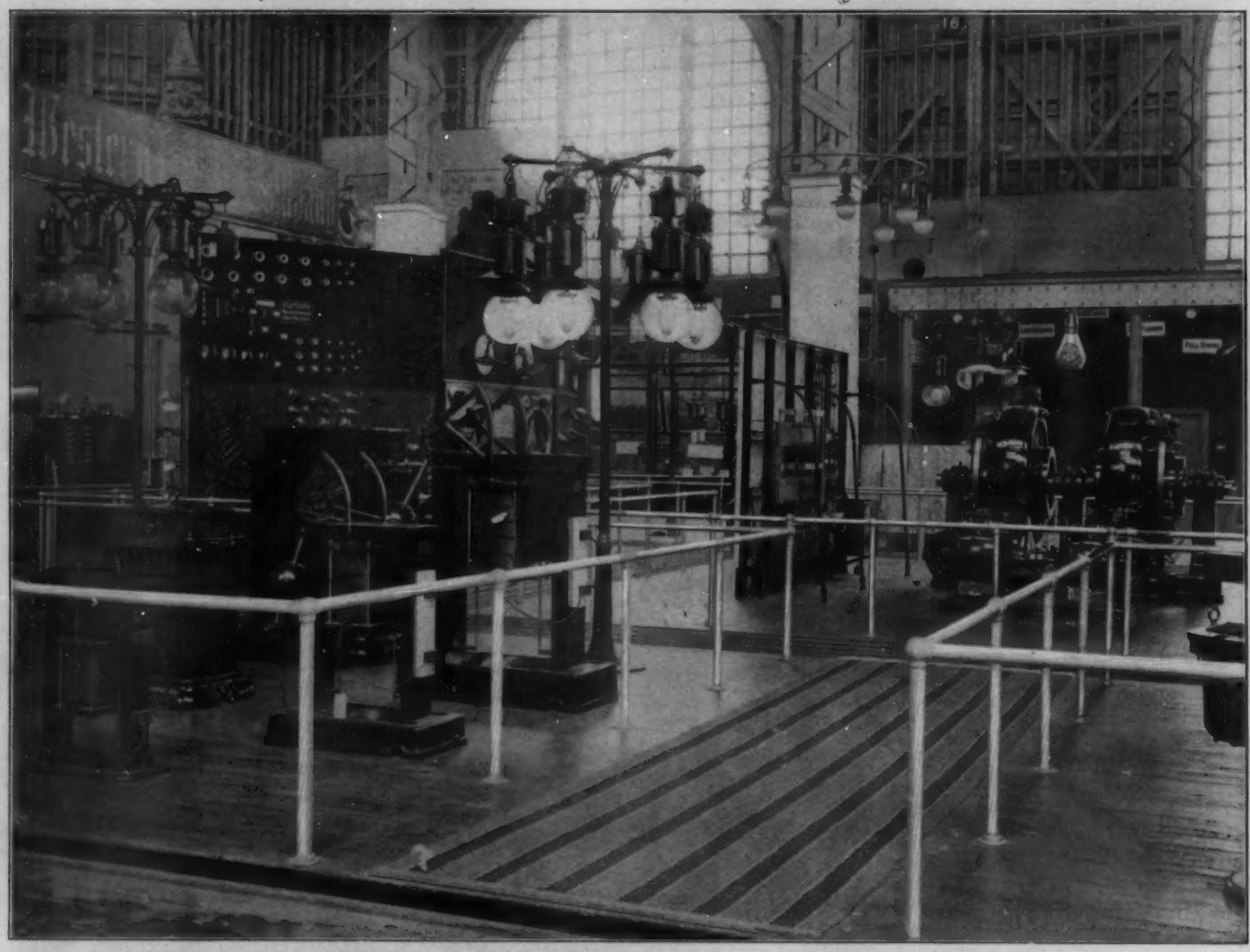
THE ASSEMBLING ROOM ALWAYS PRESENTS A BUSY SCENE



ARRANGEMENT OF THE EXHIBIT OF THE CALIFORNIA ELECTRICAL WORKS AT THE PORTLAND EXPOSITION



A PORTION OF THE MACHINERY EXHIBIT OF THE CALIFORNIA ELECTRICAL WORKS AT THE PORTLAND EXPOSITION



ARC LIGHTING AND MOTOR-GENERATOR SECTIONS OF THE CALIFORNIA ELECTRICAL WORKS EXHIBIT AT THE PORTLAND EXPOSITION

THE STANDARD GAS ENGINE COMPANY.

IT was not until June 4, 1901, that the Standard Gas Engine Company established its manufacturing plant in San Francisco, and since that time its growth has been so remarkable that today there is probably no other concern in the city which has grown into greater prominence than this, or whose products have given more general satisfaction. The reason for the achievement of such success is due to the fact that this organization is made up of men who have devoted their lifetimes to the manufacture of gas engine machinery, and that therefore each is an expert in his particular branch of the business. The Standard gas engine has met with such favor that on three different occasions since its establishment in 1901 the shops for its manufacture have been moved into larger quarters, and in each instance to factories more than twice the size of the one previously occupied. Again it has been necessary to arrange for another removal, with the result that the company is now negotiating for the purchase of a large tract of land whereon to erect that which will be the largest plant on the Pacific Coast to be devoted to the manufacture of gas engines. Of late the general offices of the company have been crowded out of the present works, which are located at 115–117 Main Street, and have been established directly across the street at 110 Main Street, where there is displayed an interesting exhibition of all sizes of the various products of the company, including gas engines, mining hoists, etc.

The officers and directorate of the company are made up of the following well-known gentlemen: Converse J. Smith, president; George W. Emmons, first vice-president; William L. Hughson, second vice-president; James S. Hawkins, secretary; Thomas Jennings, treasurer; P. Mohrdieck, superintendent, and William F. Brusher, foreman.

PELTON PROGRESS.

INCREASED activity in the water wheel trade during the past month is reported by The Pelton Water Wheel Company.

The Siskiyou Electric Power Company closed a contract for a 2000 horsepower Pelton unit for direct connection to an electric generator operating under a head of 700 feet. This is the second Pelton installation for The Siskiyou Electric Power Company.

The Mt. Whitney Power Company, near Visalia, Cal., is equiping its plant with Pelton buckets.

An interesting application of Pelton wheels is illustrated at the plant of the Arrowhead Reservoir Company, near San Bernardino. A system of hoists is operated by water power, the source of supply being taken from the reservoir. Owing to the difference in water levels in the summer and winter months it was necessary to construct a combination Pelton unit consisting of two wheels of different diameters on the same shaft. When the head decreases to a certain point the water is diverted to a smaller wheel, thus maintaining a constant speed, the diameter of the wheel being so proportioned as to afford a uniformly high efficiency at all stages of water. A similar arrangement was furnished some months ago for the Denver Union Water Company, at Cheeseman Dam, and the installation has proved an entire success.

The far East is including its share of business, there having been numerous orders of late from Japan and Java, the wheels being used for electric transmission and in connection with the coffee and tea industries. The work on the plant of the Nevada Power, Mining and Milling Company is progressing rapidly, and it is anticipated that power will soon be transmitted to Tonopah and Goldfield. The pressure pipe is now on the ground and the Pelton wheels about ready to ship.

BRYANT GOODS FOR 1905.

THE Bryant Electric Company has issued its 1905 catalogue of its will known household electrical goods which marks an advance over any previous effort. A comparison of its pages with those of former catalogues will show that the company has not only replaced, by devices of modern design, those which have become antiquated through the advance of the art, but also that it has been alive to the hitherto unsatisfied demands of the trade by producing many lines of unique, yet practical goods. The illustrations throughout the catalogue are excellent halftones of the various articles, and faithfully represent Bryant goods as they are delivered for use.

NEW JOHNS-MANVILLE BRANCHES.

In consequence of the remarkable increase of its business, the H. W. Johns-Manville Company has found it imperative to establish more branches in order to facilitate the handling of its business, and as a convenience to its customers. The new branches are in the far West—San Francisco, Seattle, Kansas City, Los Angeles, Little Rock and Minneapolis. With these in addition to the old branches, New York, Milwaukee, Chicago, St. Louis, Boston, Philadelphia, Pittsburg, Cleveland, New Orleans, London, Paris and Brussels, the company now has eighteen branches, covering the entire United States and Europe.

A quartette of men, prominent in manufacturing circles, represented the H. W. Johns-Manville Company at the International Railway Congress, whose session has just terminated. They were T. F. Manville, president of the H. W. Johns-Manville Company, J. E. Meek who had charge of the company's exhibit, L. B. Melville and James Younglove, manager of the Chicago branch. The company had a most interesting display of its asbestos and magnesia products, and electrical supplies.

WAGNER SINGLE PHASE MOTOR PATENTS.

On May 13th the St. Louis Union Trust Company, as trustee, and Wagner Electric Manufacturing Company, as licensee, brought suit against the Century Electric Company of St. Louis, alleging infringement of the United States Letters Patent Nos. 458,162, 530,176 and 130,177. These patents pertain to the Wagner Company's type of single phase alternating current motor, for the manufacture and sale of which the Wagner Company enjoys the exclusive license from the St. Louis Union Trust Company which is trustee for the owner of the patents.

QUENCY ENGINE CATALOGUES.

The California Hydraulic Engineering and Supply Company, Pacific Coast agents for the Quincy Engine Works, of Quincy, Ill., has ready for distribution bulletins Nos. 103 and 104 illustrating and describing respectively the vertical type automatic engines and the heavy duty Corliss engines manufactured by the Quincy Company. The bulletins are replete with data and information concerning the products of which they treat.

THE LOCKE INSULATOR PLANT GROWS.

The Locke Insulator Manufacturing Company announces that it has broken ground for a two-story addition, measuring 50x150 feet, to its insulator manufacturing plant, and also two very large porcelain kilns, in addition to its present equipment. These additions follow what is practically an annual enlargement, since the pottery plant and kilns are growing larger each year.

Kohler Bros., of Chicago, through their Pacific Coast Branch, the Abner Doble Company, of San Francisco, have recently installed their system on a new press of the *Portland Oregonian*, Portland, Or., and have closed contracts with the *Times Mirror Company*, Los Angeles, Cal., and the *Spokesman Review*, of Spokane, Wash. The Kohler system consists of a multiple push-button control for the electrical operation for printing presses and other machinery. The *Oregonian* has a fifty horsepower equipment and the proprietors are exceedingly well satisfied with the good results attained.

NORTHERN DIRECT CURRENT MACHINERY.

Northern direct current dynamos and motors of various types and capacities are beautifully illustrated and described in Bulletin No. 46, just issued by the Northern Electric Manufacturing Company.

REMOVAL OF THE ENGINEERING OFFICES.

Announcement is made of the removal of the engineering offices from their well known headquarters 331 Pine Street, San Francisco, to rooms 910 to 913 inclusive, in the Union Trust Building, corner of Post and Market streets.

TRANSMISSION.

FRESNO, CAL.—The transmission system of the San Joaquin Power Company is being extended to Selma and Madera.

RENO, NEV.—The new hydro-electric plant of the Washoe Power and Development Company, started operations on May 27th.

ARROYO GRANDE, CAL.—Subscriptions are being taken for patronage to an electric light plant here which will be built if sufficient inducements are extended.

LOVELOCK, NEV.—Contracts have been let for the erection of poles and a power plant for the Owens River Power Company, to convey power into Tonopah and Goldfield.

MILTON, CAL.—William O'Neil, an employee of the Calaveras Gold Dredging Company, was instantly killed on April 25th by contact with a live 25,000-volt transmission line.

FORT STEELE, B. C.—During the present year the Bull River Power and Mining Company will install a 10,000-horsepower plant at Bull River, twenty-five miles distant from here.

SANTA FE, N. M.—An investigation has been made into the advisability of developing power from the Tonto dam and transmitting it to the reservation, about one hundred miles distant.

ÆTNA, CAL.—The Siskiyou Electric Power Company has absorbed the interests of the Keplar Electric Light Company at Ætna, Cal., and is now supplying power from the Fall Creek power house.

HOOD RIVER, OR.—W. Ross Winans contemplates building an electric power plant and water works capable of developing 50,000 horsepower if necessary. The plant will be located near the falls of Hood River.

GOLDENDALE, WASH.—W. H. Fellows, recently of Spokane but now of Goldendale, is to install a 300-horsepower hydro-electric plant on Blockhouse Creek, whence power will be transmitted to this city over a nine-mile line.

HAILEY, IDAHO—The Crammer Electric Company has absorbed the property and franchises of the Idaho Electric Supply Company, and will install an entirely new plant, from which to render electric light and power service to Hailey and Bellevue.

INDEPENDENCE, OR.—A 1000-horsepower electric plant is being installed at Sidney, six miles distant, and W. P. Hawley and J. M. Healey of Portland have located 100,000 miners' inches of water for a power plant on the north fork of the Santian.

BOISE, IDAHO—The Golden Treasure Mining Company is considering the details for the installation of a power plant which it proposes to build on the Payette River. The plant will have a capacity of 10,000 horsepower, the machinery for which has not been ordered.

SUTTER CREEK, CAL.—The Standard Electric Company's transmission lines, along the Mother Lode in Amador and Cala-

veras counties, are to be extended through Tuolumne County into Merced County, a distance of about sixty miles from the Electra power house.

VICTORIA, B. C.—The Victoria Power Company has completed the tunnel for its new power plant. This is a noteworthy undertaking, being 15,000 feet in length and a section nine feet square. The work was done under the supervision of Wynn Meredith, of the Engineering Offices, San Francisco.

PROSSER, IDAHO—The Prosser Falls Land and Power Company, of which E. F. Benson is president, has filed notice of the appropriation of 5000 cubic inches of water per second, to be taken from the Columbia River at Priest Rapids, for the development of 10,000 horsepower, to be transmitted to this place.

BOISE CITY, IDAHO—Negotiations are in progress in two different directions for the transmission of electric power into this city. One project is being advanced by E. D. Dewey to take power from the Swan Falls plant, and the other, by Walter H. Graves, is to develop the power from streams in the northern part of the State.

SISKIYOU, CAL.—The Siskiyou Electric Power Company is extending its power plant by installing therein a 1000 kilowatt, three-phase generator and 1000-kilowatt motor-generator set, each of Westinghouse manufacture, a General Electric switchboard, and three 850-kilowatt General Electric transformers, together with Pelton water wheels to develop 1500 horsepower.

SAN JOSE, CAL.—The Tuolumne Electric Company of this city has ordered from The Allis-Chalmers Company one-600-kw alternating current generator, two-35-kilowatt generators and three-200-kilowatt transformers to be installed on the Tuolumne River, where a new hydro-electric power plant is nearly completed. The current to be developed will be used both for lighting and power, principally in neighboring mines, and an extension to the present plant will probably be made later on.

TRANSPORTATION.

VALLEJO, CAL.—F. A. Brandt has been granted a street railway franchise.

BENECIA, CAL.—F. A. Brand has been awarded a local street railway franchise.

EL PASO, TEX.—G. A. Nicklas has been granted a franchise for an electric lighting and railway plant.

ORVILLE, CAL.—E. W. Sutcliffe has been granted a local electric railway franchise covering the streets of this city.

BAKERSFIELD, CAL.—The Bakersfield and Kern Electric Railway Company has been granted an extension to its railway franchise.

OGDEN, UTAH—Simon Bamberger and B. Mahler have been granted a local street railway franchise to run for one hundred years.

POINT RICHMOND, CAL.—W. S. Rheem has been awarded a franchise for an electric railway to extend from Richmond to Steege.

SPOKANE, WASH.—A preliminary meeting has been held in Cheney for the organization of an electric road to be built from Cheney to this city.

BUTTE, MONT.—Reports are current that the Oregon Short Line is to equip the sixty mile Minidoka branch of its system with electric traction.

LOS ANGELES, CAL.—The Pacific Electric Railway Company is building an air line electric road from this city to Alamitos Bay by way of the Willows.

SANTA ROSA, CAL.—The Petaluma and Santa Rosa Railway Company is to build an extension from Green Valley to Occidental and Camp Meeker.

COLUSA, CAL.—E. A. Forbes has been granted a franchise for an electric railroad to extend along the county roads from Yuba City to the Sacramento River.

BAKERSFIELD, CAL.—Work has been resumed on the electric railway system which John Burson is building to connect Bakersfield with tide-water at Hueneme.

UKIAH, CAL.—Reports are current that J. Kilpatrick, a lumberman of New York, is to build an electric railroad in this county to extend through Dry Creek and Anderson Valley.

VALLEJO, CAL.—Wallace McDowell, of New York, is promoting an electric road which it is believed will connect the Vallejo, Benicia and Napa Valley electric railroad system with Lakeport.

COLUSA, CAL.—The Northern California Electric Railway and Navigation Company, represented by E. W. Sutcliffe, has been granted a franchise for an electric railway from Colusa to Princetown.

TUCSON, ARIZ.—L. H. Manning and associates have purchased from Charles F. Hoff the controlling interest in the Tucson Street Railway Company and will convert the existing horse-car line into an electric road.

MARYSVILLE, CAL.— John Martin is quoted as stating that the existing road of the Nevada County Traction Company connecting Nevada City and Grass Valley is to extend at once to this city, with a branch to Auburn.

LOS ANGELES, CAL.—The Pacific Electric Railway Company will have completed the Santa Ana branch line, which is to extend from Watts Station on the Long Beach road in a direct line to Santa Ana, by October next.

WALLA WALLA, WASH.—The Walla Walla Interurban Railway Company proposes to build its road from Walla Walla to Freewater, thence through the fruit country thereabouts to some point on the Columbia River.

LEWISTOWN, IDAHO—At a mass meeting held in this city on April 6th $35,000 was subscribed toward building an electric railway from Lewistown to Greenville, which will operate in connection with a line of streamers.

LOS ANGELES, CAL.—The Southern Pacific Company has discontinued twenty-five regular passenger trains between Los Angeles and the nearby suburban points as the result of the direct competition of electric railway lines.

MARTINEZ, CAL.—An electric railway franchise originally applied for by Henry Ells and J. R. Nistrom and to extend through Richmond to Stege and San Pablo, has been granted to the East Shore and Suburban Railway Company.

OLYMPIA, WASH.—E. C. McDonald, of the recently incorporated Pacific Traction Company states that the Interurban Electric railway line to connect Olympia and Tacoma will be in operation by May, 1906. Surveys have been completed.

PORTLAND, OR.—The Oregon Traction Company has been granted a franchise for an electric railroad, to be operated on Stark Street. This line will be extended to Hillsboro as soon as the necessary rights of way can be secured.

MERCED, CAL.—The Yosemite Valley Railway Company, of which N. C. Ray, of Coulterville, is chief engineer, and J. H. Corcoran, of Stockton, is manager, has begun grading in Merced. The Pacific Bridge Company holds a contract for the bridge work.

ALBUQUERQUE, N. M.—The Albuquerque Traction Company, of which H. A. Jastro, is president, D. K. B. Sellars is manager and Wm. Tevis, of San Francisco, and W. H. Greer, of Bakersfield, Cal., are directors, has begun the construction of a two-mile extension to its system.

SAN FRANCISCO, CAL.—The recently incorporated Ocean Shore Railway Company, which proposes to build an electric road from this city to Santa Cruz by way of Ocean View, Halfmoon Bay, Purissima, San Gregorio and other coast points, has acquired complete rights of way for the road.

GRANGEVILLE, IDAHO,—A mass meeting has been called to organize a company for building an electric road to connect the principal cities of Idaho County. The temporary officers have been elected, the president being E. M. Erhardt, of Cottonwood, and the secretary, L. F. Lennard, of Grangeville.

PORTLAND, OR.—In September next the Oregon Water Power and Railway Company is to run a branch road from a point on its main line, two and one-half miles west of Gresham, to Fairview and Troutdale, a distance of eight miles, and which will cost $250,000. Other extensions are being planned.

PENDLETON, OR.—A number of prominent Walla Walla men, headed by George W. Armour, propose to incorporate a new enterprise to be known as the Inland Empire Traction Company, to build an electric road from Walla Walla to the Columbia River, provided the so-called Portage proves successful.

SAN JOSE, CAL.—An electric railway from this city to Lick Observatory is being promoted. Two routes therefor have been surveyed—one by way of Alum Rock and the other by way of Evergreen. The maximum grade will be 5 per cent., with the exception of that just below the summit where an incline cable railway will be built.

WEAVERVILLE, CAL.—C. H. Edwards, of the Trinity County Bank, has been collecting data of the amount of freight and other business transacted between this city and Redding, in order to investigate the feasibility of an electric road. He finds that the enterprise, under existing conditions, will bring in a gross income of $32,000 per year.

STOCKTON, CAL.—It is announced that the Southern Pacific Company will build an electric railroad from Sacramento to Walnut Grove whence a branch will be constructed to Antioch and another from New Hope to Stockton. This road will be built over the rights of way of the Sacramento Southern Railroad Company recently acquired by the Southern Pacific Company.

KIRKLAND, WASH.—Otto Stendahl and John Cort have each been granted a franchise for an electric road to connect this city with North Bend. Both franchises contain the provision that either of them can be cancelled by the county commissioners as soon as actual work has been commenced under the other. The commissioners believe that this competitive scheme will work successfully.

EL PASO, TEX.—The El Paso Valley Water Users' Association proposes to build an electric railway for freight and passenger traffic from Anthony, on the New Mexico line eighteen miles above El Paso, through El Paso to a point forty-five miles down the valley, this line to connect at Anthony with other railway lines which it is proposed to build from El Paso to Organ, N. M.

WALNUT CREEK, CAL.—A mass meeting has been held under the auspices of the Central Contra Costa Improvement Association for the purpose of devising ways and means for building an electric railroad through the San Ramon Valley from Walnut Creek, Concord and Danville to Oakland. During the meeting $25,000 was subscribed towards the enterprise and about $15,000 more has been subscribed at Concord.

COLUSA, CAL.—W. H. Buster has been granted a franchise for an electric railway to run over the county road from the Compton ranch north through Princeton through the Glenn County line. It is announced that this franchise is a part of a system which Mr. Buster proposes to construct over the entire Sacramento valley. A similar franchise has already been secured in Sutter County. W. T. Forsman is also identified with the enterprise.

SALEM, OR.—The Citizens Light and Traction Company of this city is engaged in work preliminery to building and electric railroad from Salem to Portland, a distance of approximately fifty miles. A. Welch, manager for the company, states that the power plant for the operation of the road will be built on the upper Santiam River where a minimum capacity of 15,000 horsepower is available, and that the cost of the installation will not be less than $300,000.

PORTLAND, OR.—A resume of the electric railway situation in Oregon has been published by the *Oregonian*, which points out that in addition to the project proposing the building of an interurban line between Portland and Salem, it is now proposed to extend this road from Salem to Eugene. The Oregon Traction Company and the Portland Consolidated Railway Company each proposes to build an electric railway up the west side of the river to Hillsboro and Forest Grove, in Washington County, while the Southern Pacific Company in order to hold its steam railway business, proposes to equip its line with fast and powerful gasoline motor cars. A new road is contemplated for Grants Pass, and another project of magnitude consists in the consideration that is being given to the building of an electric railway line from Portland to Tacoma.

TELEPHONE AND TELEGRAPH.

RENO, NEV.—A. E. Cheney has applied for a local telephone franchise.

BISHOP, CAL.—M. A. George has been granted a local telephone franchise.

RED BLUFF, CAL.—L. L. McCoy has applied for a local telephone franchise.

FOWLER, CAL.—Dr. W. T. Crawford is organizing a local telephone system.

SAN JACINTO, CAL.—Geo. B. Hannah has been awarded a local telephone franchise.

LOGAN, UTAH—The Independent Telephone Company has been granted a local franchise.

MARIPOSA, CAL.—A private telephone line is to be built from Mountain King to Mariposa via Colorado.

ZAPOTLAN, MEX.—Esteban Arreola has been granted a franchise for a telephone system for this place.

CHEHALIS, WASH.—The Chehalis and Boisfort Telephone Company has been granted a local telephone franchise.

EUGENE, OR.—The Bethel Telephone Company of this city will extend a telephone line to Bethel and elsewhere.

RIVERSIDE, CAL.—The Southwestern Home Telephone Company has applied for a county telephone franchise.

POMONA, CAL.—Oscar Overholtzer has been awarded a contract for the installation of a municipal fire alarm system for $2375.

SANTA ROSA, CAL.—S. C. Oldfield, of Green Valley, has applied for a county telephone franchise to be awarded on June 7th.

TONOPAH, NEV.—The Bull Frog, Tonopah and Las Vegas Telephone Company is extending its system from Bull Frog to Las Vegas.

MODESTO, CAL.—The Grange Company of this city will soon build a private telephone line from here through Merced to Madera.

BAKERSFIELD, CAL.—W. E. Blaisdell and F. C. Clark have been granted a franchise to operate a telephone line in Kern County.

BRIGHAM CITY, UTAH—The Independent Telephone Company has been granted a franchise for its proposed operations in Box Elder County, Utah.

RED BLUFF, CAL.—The Signalphone Company, of Milwaukee, has been awarded a contract for the equipment of the municipal fire alarm system to cost $3175.

VANCOUVER, B. C.—The British Columbia Telephone Company is to expend $250,000 in the new building and in making general improvements of its system.

BROWNSVILLE, OR.—The farmers' telephone lines in operation hereabouts are being connected with the local exchange of the Brownsville Telephone Company.

HONOLULU, T. H.—The Standard Telephone Company, Limited, has applied for a franchise to operate an automatic telephone system in this city.

CITY OF MEXICO—T. F. Maguire, general manager of the Mexican Telephone Company, announces that by June 1st his company will begin laying an underground system.

PASADENA, CAL.—The Sunset Telephone and Telegraph Company is undergrounding its overhead wires on East Colorado Street, between Merango and Oakland Avenues.

WINNEMUCCA, NEV.—The Sunset Telephone and Telegraph Company will extend its long distance line from Reno to Ogden and Salt Lake City during the present summer.

EL PASO, TEX.—The Southern Independent Telephone Company has awarded a contract for the construction and exclusive use of the Strowger apparatus throughout its system.

ALBUQUERQUE, N. M.—The Colorado Telephone Company has completed arrangements for building a long distance telephone line from Las Vegas to Socorro, a distance of 200 miles.

WILLOWS, CAL.—Some local business men are organizing a company for the purpose of building a telephone line from Elk Creek in Glen County, to Round Valley in Mendacino County.

NAPA, CAL.—A. D. Butler has been awarded a franchise for a telephone system to extend through Brown's Valley and the Redwoods, and which will connect with the Sunset office at Napa.

VACAVILLE, CAL.—The Mutual Telephone Company of this city has effected permanent organization by the election of O. H. Allison, president, T. C. Mize, secretary, and G. W. Crystal, treasurer.

ALBUQUERQUE, N. M.—The Consolidated Telephone, Telegraph and Electric Company has bought the property and franchises of the Gila Valley Telephone Company, subject to stockholders' confirmation.

JULIAETTA, IDAHO—The Potlatch Telephone Company has been organized by R. H. and E. W. Porter, and will install a telephone system in Juliaetta, Kendrick, Southwick and Leland and the country adjacent thereto.

OAKLAND, CAL.—A telegraphic experiment made to determine the time consumed in signaling from the Naval Observatory at Washington, D. C., to the Chabot Observatory, Oakland, demonstrated that it was one-tenth of a second.

SAN BENITO, CAL.—The citizens of Bear Valley have organized the Mutual Telegraph Company, with O. I. Butterfield as president and H. E. Hain as secretary, and will build a line from Willow Creek to San Benito via Bear Valley.

OAKLAND, CAL.—George W. Dow, a lineman, has entered suit against the Sunset Telegraph and Telephone Company for $20,000 for injuries received by shock alleged to have been caused by negligence on the part of the defendant.

MACLEAY, OR.—John Craig of this place has organized a company which will build a telephone line to connect Macleay with Red Barn, Shaw and Fair Ridge. The system will also be connected with the lines of the Pacific States Telephone and Telegraph Company.

LOS ANGELES, CAL.—The Kellogg Switchboard and Supply Company, of Los Angeles, has recently secured contracts for common battery switchboards at Gardena, Oxnard, Santa Paula and Redondo, Cal. There are at present twenty-eight exchanges in southern California equipped with Kellogg telephones and apparatus.

SAN FRANCISCO, CAL.—The Home Telephone Company, of San Francisco, is securing signatures to contracts for full metallic circuit telephones in San Francisco, at the rate of $8.25 per month, with the proviso that service shall begin when 7000 bona-fide subscribers have been connected to its proposed exchange. The new plant will cost about $4,000,000, and its construction is believed to be assured.

REDDING, CAL.—The farmers of the Oak Run section, in conjunction with the directors of the People's Telephone line in Fall River and Burney Valley, will extend the telephone line from Redding to Montgomery Creek, where it at present joins the Buick-Wengler telephone line. The proposed line will run from Montgomery Creek down to Oak Run and Millville, and then go to Redding by way of Palo Cedro. Bella Vista may also be included.

PRESCOTT, ARIZ.—The Prescott Electric Company and the Consolidated Telephone, Telegraph and Electric Company, of Tucson, have consolidated in Northern Arizona, and all lines north of Maricopa County are to be controlled by the Prescott Electric Company. Offices of the Consolidated (or Sunset) Company are to be closed in this county and the connections transferred to the Electric offices. The service is to be greatly improved. Connections are now being made between Tucson and Los Angeles.

SAN FRANCISCO, CAL.—A press dispatch from Washington states that the Bureau of Equipment is making arrangements to carry out the plan for the establishing of wireless telegraph stations on the Pacific Coast, where there are now three—at the Farallones (just put in working order), in San Francisco and on Yerba Buena Island respectively. It is proposed to add some six or eight stations along the coast at present, and arrangements are being made for installation at Guam, Hawaiian Islands, Midway Island and Cavite. Plans are being drawn with a view to increasing the power of stations so as to maintain unbroken ranges of communication from Cavite to Guam, thence to Midway, thence to Hawaii and between these islands and San Francisco. This last reach is the longest, being more than 2000 miles, but it is believed that if the physical obstructions in the Hawaiian Islands can be overcome there will be no difficulty in establishing communication.

ILLUMINATION.

BRANDON, OR.—The Brandon Woolen Mills Company, of which R. E. Bedillion is manager, is contemplating the installation of an electric plant for lighting its mills and the town.

KENNEWICK, WASH.—C. E. Wood, of Genesee, Idaho, offers to put in an electric light system and a flouring mill here at once if he can secure a franchise for the electric light system.

EUREKA, CAL.—The North Mountain Power Company has applied to the City Council for permission to erect poles and wires in the principal business and residence sections of the city and expressed its intention of supplying light and power in the immediate future.

OAKLAND, CAL.—As the result of a conference held between the parties in interest, it has been agreed that all telegraph, telephone and electric lighting and power companies operating in Oakland shall at once begin the removal of all wires in the business center, placing them under ground as rapidly as possible.

ALAMEDA, CAL.—City electrician J. B. Kahn has begun the work of taking down the tall steel masts that for years have been a feature of the illuminating system of Alameda. The lamps now used on the masts will be placed on separate poles of the usual height. The towers are from seventy-five to 125 feet high.

GOLDENDALE, WASH.—H. W. Fellows, of Spokane, has placed a proposition before the city of Goldendale, to construct a electric light plant involving an outlay of about $50,000. Power will be developed from the Little Klickitat Falls. It is understood that the construction of a flouring mill at Centerville, to be erected in the near future, and operated by electricity, is included in the scheme.

GAS.

HONOLULU, T. H.—The Honolulu Gas Company, Limited, of which the W. F. Boardman Company, 530 Market Street, San Francisco, is purchasing agent—and not W. R. Castle of Honolulu, as erroneously stated in the last issue—has completed its new gas works in the Iwilei district and they will be in operation during the first week of June. The plant is being installed by the California Light and Fuel Company. L. P. Lowe is one of the principal stockholders of the Honolulu company, for which the Boardman Company also acts in the capacity of business manager.